THE

ELECTRICAL REVIEW.

VOL. LIX. OCTOBER 26, 1906. No. 1,509.

ELECTRICAL REVIEW.

Vol. LIX.] CONTENTS: October 26, 1906. [No. 1,509.

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LONDON COUNTY COUNCIL TRAMWAY FINANCE.

ONE of the great difficulties which face the business man in appealing to the public for an impartial examination into the accounts of the London County Council, is the unfortunate introduction of party politics into the constitution of these municipal bodies. Instead of selecting the best men for the purpose, irrespective of whether they are Radicals, called Progressives, or Tories dubbed Moderates, Liberal Associations bring forward the former, and Conservative Unionist societies the latter, and the contests are between the rival party men, while the independent men of business go to the wall.

It is this condition of affairs that prevents the investigation in a rational businesslike way of the position of the tramway finance of the London County Council, and the result of municipal trading in undertakings which ought to have been left severely to private enterprise.

Under date of 10th inst., the London County Council issued a report upon street improvements and tramways, which discloses astounding facts with reference to the apportionment of the cost incurred in improvements undertaken in connection with tramway schemes. Captain Swinton, at whose instance the report in question was ordered, accuses the Council of misleading both Parliament and the ratepayers, through their Highways Committee, and points out that he is making "a definite charge of a grave character."

The public have been led to believe that the cost of the street widenings and improvements necessitated by the construction of tramways has been equally divided between the local authority, the county fund, and the tramway account, but the fact appears to be that in order to relieve the tramway undertaking, these costs have been most unequally divided, so that out of £4,500,000 spent in securing the right of way for the tramways, only £377,000, or about one-twelfth, has been debited to the tramway account.

Examples of these divisions of cost are given in the following cases:—Mare Street, Hackney, only £482 charged to the tramway account out of £576,100; Old Street, £81 out of £370,137; Nine Elms, £58 out of £160,300. In this way the tramways are subsidised at the expense of the ratepayers, and the pretence is made that the London County Council, by their good management, do better than private companies.

We need hardly say that no such generosity is shown in the case of the private companies, who appear to be fair game in the hands of the local authorities, who obtain as much as possible out of them for street widenings and improvements, as the price of their consent to tramways being constructed at all, however important for the convenience of the public.

There are many other items of importance which are sub-

ject to the same comments, the costs incurred in the departments of the solicitors, controllers and clerks being all apportioned so as to charge as little as possible to the tramways. Thus out of solicitors' bills for £15,513, only £500 finds its way into the tramway accounts, and £300 of the controllers' charges, amounting to £16,506.

No valid answer has been attempted to these grave charges, and it is an aggravation of so serious a position for Mr. McKinnon Wood to try and brush them aside by accusing his opponents of being "opposed to all trams and all improvements."

Is it substantially true or not that out of £1,106,537 expended in three improvements on laying tramways only £621 was charged to the tramways? It is no answer to accuse the critics of such deceptive practices of being opposed to all tramways—they may or may not be—but that does not dispose of the matter. The contention of the advocates of municipal tramways is that they are more advantageous to the ratepayers than taking a rental without liability from a private company, and ensuring a certain profit with no trouble or risk.

Let us see how the account stands with reference to the North Metropolitan tramways, which, when leased to the company, realised the only profit ever made on tramways by the London County Council.

In the report of Mr. T. Barclay Cockerton on the accounts at March 31st, 1905, it appears that the revenue from the Northern system showed a surplus of £22,836, the Southern system £7,055, but on the general revenue account there was a deficiency of £18,467, leaving a net surplus of £11,424, which was about half the profit obtained from the rentals received from the private company, the other half going in reduction of the losses sustained by the London County Council on their own working of the Southern tramways.

In the following year (ending March, 1906) the receipts from lines not worked by the Council, by way of rent, were £61,740 17s. 4d. from the North Metropolitan Tramways Co., and £371 17s. 4d. from the Metropolitan Electric Tramways Co., as lessees of the Middlesex County Council, and £298 6s. 8d. from tenants of properties, giving a total of £62,411 2s. 4d. The expenditure in connection with these lines amounted to £1,458 17s. 7d., leaving a net surplus of £60,952 3s. 9d. Deducting debt charges, £35,695 9s. 6d., the surplus revenue carried to appropriation account is £25,256 14s. 3d., as compared with £22,836 in the previous year. In spite of such facts as these, the defenders of the Council's municipal trading have the effrontery to claim success for their great enterprise.

Another and very important question in connection with the accounts is the altogether insufficient amount provided for depreciation, the balance standing to the credit of this fund on March 31st, 1905, being only £66,607. The auditor states that he understands that the Council are considering the sufficiency of the provision for depreciation!

In an article we published on December 26th, 1902, we referred to the treatise of Mr. Donald McColl, the late bookkeeper of the Glasgow Corporation, on the question of tramway depreciation, in which he stated, as a principle, that "depreciation should properly be provision for renewals only corresponding to the shrinkage in value of the assets, and that ordinary repairs executed must, in addition, be charged year by year against revenue."

It is admitted that 1d. per car-mile should be set aside for depreciation, and as only half that amount has been reserved, it would require £45,000 to make it up to 1d., against 2½d. set aside by the Glasgow Corporation.

In Glasgow, £450 per mile is charged annually for renewal of the permanent way, the average life being estimated at 10 years. The idea of the sinking fund as the means of providing for depreciation as well as repaying loans has been practically abandoned, and Mr. McColl's rhyme on the subject may be repeated:—

> Your sinking fund pays what you borrow,
> But does not write down your assets;
> Depreciate, or to your sorrow
> Renewals will add to your debts.

The mileage of the London County Council's completed tramways is about 106 miles, so that if Glasgow conditions apply to London, the depreciation of the permanent way requires an annual provision of £47,700, apart altogether from rolling stock, and any difference arising out of the maintenance of a conduit instead of the overhead system.

The mileage will be considerably increased during the latter end of the present and during next year. For the session of 1907 the Council propose tramway extensions involving a further mileage of 32½ miles and a further expenditure of £757,200, which will bring up the total investment in tramways to about £5,000,000.

It appears to us that two things are necessary to satisfy the public as to the real state of affairs. In the first place, a Commission of Inquiry into all the facts connected with the London County Council's tramway enterprise; and in the second place, means should be taken for informing the public, so that the forthcoming election of the new Council may contain business men capable of dealing with the whole problem.

If the elections are conducted on mere party lines, the results may or may not be satisfactory. Some thoroughly independent organisation is necessary, apart from all political bodies, to educate the public, and to find the right men to represent them.

The Age Limit.

It cannot have escaped notice that there has been an increasing tendency, when advertising for engineers for municipal undertakings, to impose an age limit. The usual age is 40, and this particular age has come into special prominence, owing to the recent Sunderland fiasco, in which a noteworthy feature was the special pleading of one member of the Committee that a man of 42 years of age should be appointed, because he was a fit and proper man for the post. Now, if a man of 42 was fit for the post, why was the age limited to a maximum of 40? We happen to know of other men possibly as good as the selected candidate, who refrained from applying because they were over 40. Merely being under 41, but actually past 40, is sufficient to deter some men from applying. Under the circumstances, therefore, it was right and proper that the Committee should rescind the appointment of a man who was rising 43, but the whole subject must surely appear to the outsider as one fraught with fatuous folly. Many councillors are imbued with the belief that all work and industry should be municipally controlled. Under present conditions the effect is curious: men of 45 are condemned as useless by committeemen of 70 to 80 years of age! It is quite time that a protest should be made against the unfairness of the age rule.

We have little hesitation in stating that, to begin with, the majority of committeemen are totally unable to judge as to the fitness of an engineer for his post. Testimonials play far too great a part in their decisions, and the testimonials to which they pay most attention are not those which testify to a candidate's technical experience or to his commercial ability, but those from mere aldermen, councillors, chairmen of committees, *et hoc genus omne*.

Moreover, only too often municipal appointments are decided neither by merit and ability nor by testimonials from protecting councillors, but by influence exerted by the friends and connections of a favoured candidate. This kind of thing is less, if at all, prevalent in appointments made by companies, who also appreciate the value of what used to be called "the experience of a lifetime," but in future, presumably, must be regarded as a discreditable

burden of years. What, we should like to know, is the view of these lovers of youth on the appointment of a Sir George Gibb, a Gisbert Kapp, a Lord Roberts?

Railway Accidents and Fires.

From time to time, in spite of the strictest regulations and the utmost care on the part of our excellent railway managers, disastrous accidents occur on British railways, and doubtless will continue to take place. Apart from the many other horrors of such unhappy events, one of the worst features, as we have often pointed out, is the frequent accompaniment of a violent conflagration, which not seldom results in the death by fire of persons who in its absence might well have been rescued. In countries where heating-stoves are carried in the coaches such fires may often be shown to originate in the scattering of red-hot cinders, &c., amongst the *débris*; but in this country, when any attempt is made to cope with the rigours of our occasionally bitter weather, it takes the form of heating by steam or warming-pans, which can by no possibility give rise to fires. The presence of cylinders of compressed gas beneath the coaches, however, constitutes a means of ignition of the highest efficiency and certainty. Repeated instances in recent years of gas-lighted trains set on fire on collision or derailment have testified to the capabilities of this agent of destruction, and have induced strong expressions of opinion on the part of the Local Government Board Inspector as to the dangers of gas lighting.

The cylinders, strongly constructed of steel, are not easily ruptured, but this does not hold good as regards the system of piping and the reducing valves through which the gas is led to the burners, and it cannot be doubted that any serious damage to a coach must inevitably set free the contents of the reservoir. The gradual liberation of the gas, indeed, is probably more fraught with danger than would be its instantaneous discharge by the rupture of the cylinder, as its tendency is to maintain a combustible mixture in and about the wrecked coaches all the longer. A mixture of one part of gas with sixteen of air is readily combustible, and diffusion takes place rapidly. The ease with which sparks are produced by blows on stone and iron provides a ready means of ignition, and, as collisions take place more frequently by night than by day, this is supplemented by the gas and oil lamps then in use. The case against gas, in fact, seems complete.

Our reason for discussing this matter in detail is the fact that it has come to our knowledge that some railway-men refuse to admit that gas is to blame, and, in default of other scapegoat, they attribute such fires as those in question to hot coals thrown out of the locomotive firebox. That such a cause should be soberly put forward seems to us the height of absurdity. Anyone acquainted with the construction of a firebox knows that only with the greatest difficulty could cinders escape from its interior. The effect of the sudden stoppage is simply to throw the fire up against the firebox tube-plate, and no one can possibly allege that coals or cinders possess sufficient elasticity to rebound. Even should the fire-door be open, how could the cinders possibly travel backwards over the tender to the coaches and ignite the latter? The hot ashes in the ash-pan are also enclosed, and, besides being finely divided, and unable to ignite wood when scattered upon it, they are equally unable to reach the coaches. How, then, can fire from the locomotive seize upon the train? We submit that it is practically impossible.

As stated by the L.G.B. Inspector, the only safe means of train lighting is electricity. We challenge anyone to show that a train lighted by electricity has ever been set on fire by its agency when in collision or derailed. Apart from its many advantages in other respects, electricity is the lighting agency *par excellence* on the score of safety alone, and as such its use ought to be made compulsory.

ELECTRICAL TRANSPARENCIES FOR ADVERTISING.

By DONALD S. MUNRO.

Electrical signs are now regarded as among the most profitable mediums of advertising. Advertisements consisting of bright artificial lights were used for a long time, chiefly in connection with shows of various sorts, theatres, and temporary exhibitions. Associations of this kind lent vulgarity to most of the first electric signs, which were generally of a somewhat crude and glaring nature. Within the last two or three years, however, much ingenuity and art have been shown in improving the designs and softening the effect of these fixtures. New York, Paris, Berlin, Brussels, and even London have had a new night aspect given to some of their principal streets. Broadway and the Boulevard des Capucines simply burst into flower after dark, and thousands of pounds have been spent in these two streets alone on electrically-illuminated devices of all kinds. White and red are the prevailing colours. There are signs which flash out and in; signs which appear to be written by an invisible hand; occasionally the inscriptions appear sentence

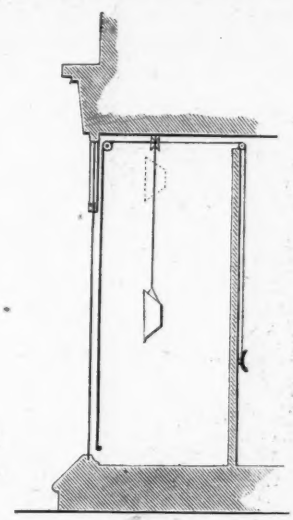

Fig. 1.

by sentence or word by word. Clock faces are arranged to change colour, and sometimes the time of night is made to appear at regular intervals. Other clocks are arranged with concentric rows of lamps round the face, and these light up rapidly, one after another, and give the effect of a revolving wheel of coloured light. Vertical cylinders are arranged with spiral rows of lamps up their length, and these when revolving give the effect of a screw boring itself into the darkness. Electric street cinematographs are now quite common, and mechanical devices which attract by reason of the unusual contortions which the attached lamps make against a black background. Apparently there is no end to ingenuity in this sort of thing.

Electric motors, compressed air, hot air, water, clockwork, electro-thermal arrangements, pendulums or springs, and combinations of some of these are all in use to operate the lights on such signs.

There is no doubt that these advertisements are effective quite apart from the attraction of novelty, and electric sign-boards have come to stay.

After dark in large cities the chief streets are filled with crowds whose minds, released from business, are consequently much more receptive to outside influences.

Shopkeepers all over the world are finding this out, and more and more are lighting up their shops at night. All interested in the increased use of electricity will not quarrel with the tendency toward late lighting, and should do all in their power to encourage this state of matters.

It should be pointed out to shopkeepers that their advertisements are useless, and their shops might as well be non-existent during the dark hours, if they are not illuminated or fitted with an electrical sign of some sort. The sign has

proved of considerable service in the United States in securing business for the supply companies. Some companies there have adaptable boards which they lend to their clients free of cost. The client gets the advertisement, and the company gets paid for the increased consumption of current. An arrangement like this could with advantage be used here in many districts.

Quite apart from the expense of electrical energy, however, many people who are alive to its advantages find that an electrical sign is a very expensive thing to buy. The switching arrangements, if complicated, are apt to break down, and as most boards are exposed to wind and rain the repairs must be frequent. Some time ago the writer protected an illuminated window blind. It is a cheap and effective substitute for an outside sign, is not liable to deterioration through exposure, and may be worth a description.

It is intended principally for shops and warehouses, which usually have their blinds drawn down after dark. The ordinary blind is removed and its place taken by one made of opaque cloth. An opening or stencil is cut in this cloth, and a panel of semi-transparent cloth is sewn or pasted

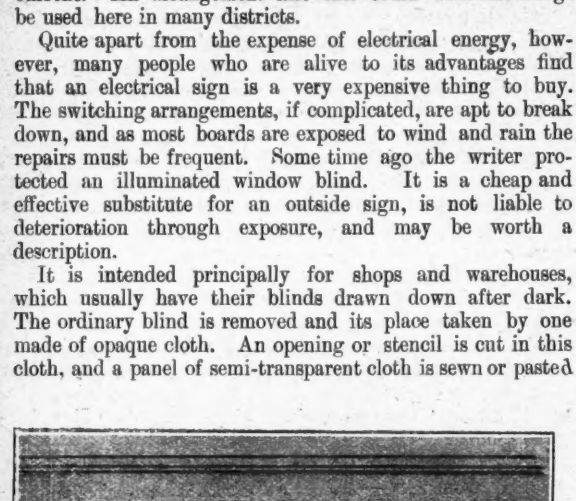

Fig. 2.

in. The advertising matter is painted in colours. Light holland or tracing cloth make good materials for this panel —the outline of which may be round or rectangular or any shape desired. The panel may be lit from the usual window fixture, or better, as shown in fig. 1, p. 655. A 32-c.p. lamp with mirror reflector is hung over a pulley, and the supporting cord is taken along to the side of the window and attached to the window-blind cord. When the blind is drawn up, the light is also drawn up, out of the way, and is opposite the centre of the panel when the blind is down. Fig. 2 is from a photograph taken by the light shining through the transparency. The wording does not necessarily show a lack of the sense of humour in the firm referred to.

The arrangement is not costly, and the panel being about the level of the eye, to those in the street, does not need to be very large. Of course, the whole window opening may be used, but this requires more light, and the effect is less vivid. No space is taken from the window for the display of goods. These blinds may also be fitted to windows above the ground floor when the warehouse occupies the whole front of a building. To turn off the light at midnight, a time switch may be used, or a secret switch outside the shop may be put "off" by a policeman.

For a cheap and simple advertising sign this arrangement is exceedingly effective, and appeals to many who would not think of fitting up a regular illuminated signboard.

SOME PRACTICAL NOTES ON THE COMMERCIAL DEVELOPMENT OF ELECTRICITY SUPPLY UNDERTAKINGS.

By R. BORLASE MATTHEWS, Wh. Ex., A.M.I.C.E.

Organisation.*

It is impossible to lay down a universal scheme for a "new-business" department that will be suitable for all towns of all sizes, but a general outline may be given, based on the experience of successful operation in many cities and towns, that can be so modified and adjusted as to meet the local conditions. Such an outline will doubtless be of great assistance if no other aid is obtainable; but, since an active scheme of commercial development has proved itself in so many instances to be such a profitable venture, it is undoubtedly the wisest plan at once to obtain the advice of a consulting engineer, experienced in the modern methods of commercial development, who, with his special knowledge and by taking into consideration the local conditions, will be able greatly to facilitate the establishment of the department on a sound basis, and to economise much valuable time and avoid fruitless expenditure in so doing.

In a town of 20,000 inhabitants or over, undoubtedly as a first step, the best course is to employ a capable and energetic man as manager of the department—if possible a man with the instincts of a salesman, who has been trained in the office of a central station, and, therefore, has a good knowledge of the conditions of operation and distribution, and has had some experience in dealing with prospective customers: that is to say, a man who, to a certain extent, will be familiar with the work he will be called upon to do. His age should not exceed 35 years, as in a position of this kind, the energy of youth is of great value.

Having appointed such a man, the first move he should make is towards the establishment of an attractive office and showroom in a good location on one of the main streets. Here the general public can easily make inquiries, pay their bills, and see actual examples of methods of lighting and the various forms of labour-saving electrical appliances that can be utilised in their homes or businesses. Most of the manufacturers and the local wiring contractors are glad to co-operate with electric supply undertakings by loaning them apparatus for exhibition; and the rent and the interest on the expenditure incurred in furnishing such an office and showroom, are far more than covered by the additional business that can be secured through their aid.

The next matter that should receive attention is the securing of the services of suitable assistants to act as canvassers. These canvassers need not be men who require high salaries, as the more important transactions would always be closed by the management; they should be of good address and should preferably be men who have had some experience as travellers or salesmen—not necessarily in the electrical line. In a fairly prosperous town, something like one canvasser per 15,000 inhabitants will be required.

The System.

The keynote of modern successful business is system, and in these days of keen competition, the more perfect the system the more prosperous the business. In starting a "new-business" department it is very very essential that a good system be employed, for, intelligently handled, it will be the means of saving much time and labour.

When the general scheme of the "system" to be adopted has been worked out, a general instruction book should be prepared containing notes on the general schedule decided upon and copies of instructions relating thereto. Such a book should be of the loose leaf form so that fresh instructions can be added in their correct place from time to time, as the system develops in its details. It is advisable to maintain duplicate copies of this book, one for the use of employés and the other for the manager's reference. A book of this description will prove of great value when a new employé is engaged, and will generally assist in the smooth operation of the system.

Advantage should be taken of those modern office methods of keeping records—the vertical file with a separate

* The introductory article of this series appeared on pp. 650-1 of our last issue.

numbered folder for each name, and the card index. One standard size of card should be used, preferably the 5 in. × 3 in., of thin material, so that it can be easily used in the typewriter.

Each customer should be allocated a number, to facilitate reference to the records of the accounting department, correspondence, installation data, &c. To the rotation number should be added a letter to indicate whether the building occupied by the customer may be classed as (R) a residence, (S) a shop or business place, or (P) a place where power is used.

The first thing that should be done in the actual work of the department is the compilation of a card index of existing customers, as it is essential that accurate information should be on hand ready for the time when the question of an increase in the lighting or power load has to be considered, and also to satisfy the queries usually put by a prospective customer as to what his neighbour is doing. Canvassers, by referring to this list, can avoid the error of canvassing existing customers. This index should be arranged in alphabetical order of the streets of the city in which the building is located, and not according to the initial letter of the customer's name, or the number that has been allotted to him, since from the point of view of the supply of current, the building is the permanent feature and the occupant merely temporary. On the same card should be placed the customer's rotation number and a note as to his connection in equivalent 8-c.p. lamps and in horse-power of motors installed, &c. The cards should be distinctively marked by a rubber stamp, say with a broad red band across the centre, so that they may be readily noted when placed with cards containing names of those who are not customers.

In the vertical index file, in the folder under the customer's rotation number, in addition to copies of any correspondence, a form should be kept containing items of useful information that cannot conveniently be put on the cards. A note should also be made concerning any special applications of electricity at the consumer's premises, with any interesting data thereon. All information should be verified as far as possible by actually visiting the premises of the customer.

While it is advisable to get the above-mentioned particulars together as early as possible, it is, of course, very important to commence the actual canvassing, at the same time compiling a record similar to that mentioned above, of all buildings and their occupants, within reach of the existing service mains. To aid in getting this information together, maps of the distribution system should be prepared, with the various distributing mains indicated upon them in colours. This list completed, the remaining buildings in the city must be canvassed and listed in the same way. In both lists the form of illumination employed, with details as to the number of gas jets, Welsbach burners, average monthly bills, the name of the owner of the building, &c., should be carefully noted. To aid in obtaining the occupants' names, the local directory will afford considerable preliminary assistance, and the telephone book will form a useful check, but these cannot usually be fully relied upon, and it is most necessary to obtain absolutely exact records. Even such an apparently small item as getting a man's initials correctly, and his name spelt properly, is of more importance than appears at first sight, for many men are very sensitive on this point, and to rub a man the wrong way, even in the slightest degree, when soliciting business is a mistake which should be carefully avoided. A correct and complete record is always of value, anything else is worse than useless. Having obtained the record, it must continually be kept up to date by following up all removals which take place in the town, information concerning which should be sought from daily papers, from friendly estate agents, auctioneers, architects, contractors, and from all others who are likely to know of such changes.

Too much stress must not be laid on the "system," for, after all, it is but a means to an end; alone it is of very little avail—it must be backed up by sound common sense and good management.

Canvassing.

With the collection of the above-mentioned information, of course, commences the real canvassing. The way should be prepared as far as possible by suitable advertising matter, and the day before a call is made, a postal card should be sent making mention of the fact, thus paving the way for a favourable reception.

The most likely places should first of all be attacked—the shops in the main streets and the factories, then the smaller shops and larger residences should receive attention, and so on until the whole town is canvassed. The canvasser, after making a call, should not omit "to leave his card." The card suggested as advisable would be a post-card addressed to the central station, and having on the back a printed request for a representative to call, spaces being left for filling in the time and the day which would be most convenient to the sender. This card, if placed by the canvasser on the telephone, or other convenient and prominent place, will at least serve as an advertisement and reminder of the existence of his department, even if it is never actually posted.

The canvasser must be provided with a certain amount of "ammunition" before he makes his call; he may or may not be a technical man, but he must be thoroughly coached and posted in those matters with which he has to deal, for it is fatal if the prospective customers realise that they are talking to someone who does not know much more about the electrical business than they do. In residence canvassing it is well to endeavour to be allowed to estimate for wiring the house. The specification should be prepared in two ways, one with the wiring done in the way that best suits the ideas of the householder, and the other in such a manner that the figure is reduced as much as possible, by omitting all lights but those which are absolutely necessary, confining the lighting to the living rather than the sleeping rooms, and thus giving an idea of the minimum price an installation could be put in for; the lower figure also shows up the difference between necessity and convenience, and presents in a somewhat better way, what at first may appear to the average householder to be a very high figure—the householder being usually unacquainted with the cost of installation work, whether for electricity or gas. Chandeliers and other fixtures should always be figured as extras, as taste varies so much in the selection of these fittings, and their price added to the cost of wiring, makes the latter appear excessive.

A standard form should be prepared for use in getting the wiring data together, to ensure that nothing is omitted, and also so as to see that if the work is bid upon by more than one contractor, they base their estimate on the same specification.

As a rule, it will be found best that the canvasser should not make an estimate at the time of calling, though it is well that he should be able at times to give an approximate figure, making it quite clear to the prospective customer that this is so, and at the same time mentioning that an accurate figure will be presented in the course of a few days' time.

HIGH-SPEED ELECTRIC MACHINERY: WITH SPECIAL REFERENCE TO STEAM TURBINE MACHINES.

By PROF. SILVANUS P. THOMPSON, D.Sc., F.R.S.

(Abstract of Howard Lectures delivered before the Society of Arts, *January 18th and 25th, and February 1st, 1906, and published in the Journal of the Society.)*

Output of Electric Generators.

Various factors influence the output of electric power which can be obtained from an electric generator of given construction.

The current that can be drawn from the machine at the working voltage is limited (*a*) by the heating of the armature or other part of the machine; (*b*) by the reaction of the armature interfering with the voltage of the machine; (*c*) in the case of continuous-current generators by the difficulty of sparkless collection of the current. On the other hand, the voltage of the machine is limited by other considerations; (*d*) the speed at which the armature is driven; (*e*) the magnetism provided by the field-magnets; (*f*) the adequacy of the insulation of the conductors. Besides these limitations which affect the two factors separately, there is a limitation due to them jointly—namely, (*g*) the adequacy of the mechanical construction of the armature, its mounting and its shaft to withstand the application of the torque, when running at the actual speed. There are yet two other limitations to be considered

—namely, (*h*) the prescription of some particular efficiency, and (*i*) the capacity to endure a temporary overload of some prescribed amount for some prescribed duration. The former of these is practically bound up with the limitation of the temperature rise, since any machine which has a low efficiency is bound to evolve as heat the energy which it wastes; and the latter is more or less involved in the compliance with the requirements at normal load and in the provision of ample margins of safety.

The recommendations of the Engineering Standards Committee define the conditions that shall govern the rating of the normal output of generators for continuous, as distinguished from intermittent, employment as follows:—"The output of generators (and motors) for continuous working shall be defined as the output at which they can work continuously for six hours and conform to the prescribed tests." No detailed regulations as to tests have yet been issued, pending further investigations as to the safe limits of temperature rise that are permissible. If, following the general lines of the American and German rules for rating, we assume 50° C. as the maximum rise in continuous working, and an overload capacity of 25 per cent. for not more than two hours, we shall probably not be far from the ultimate rules to be laid down by the committee. The Standards Committee has also laid down for alternators the additional rules that their voltage curves shall, under all working conditions, be as nearly as possible a sine-curve, and that they shall not have a greater percentage pressure-rise (from full-load to no-load), with the same speed and excitation, than 6 per cent. on a non-inductive load, nor more than 20 per cent. on an inductive load having a power factor of 0·8.

Let it be then assumed that by rules such as these the proper rating of any generator can be arrived at, the questions immediately before us are in what relation does the normal performance of a machine, that is, its rated output, stand to the design of the machine and ultimately to its cost, and in what way are these affected by the engine speed.

Manufacturers are naturally desirous of producing as cheaply as possible the machines that are to fulfil the required specification. The prime cost of materials, iron, steel, copper and mica or other insulating material, and the cost of labour affect the design to be adopted.

Let us consider the fundamental formulæ which state the dependence of the electromotive force of a generator upon the speed, the number of armature conductors, and the flux per pole. We write the following symbols:—

E = electromotive force, in volts or virtual volts,
n = revolutions per second = R.P.M. ÷ 60,
Z = number of conductors all round the armature,
p = number of poles,
c = number of circuits through the machine,
N = flux from one pole.

Then we have as the general equation:—

$$\mathrm{E} = \frac{p}{c} \times n \times \mathrm{Z} \times \mathrm{N} \div 10^8. \quad \ldots \quad \ldots \quad (1)$$

For alternating electromotive forces the expression needs to be multiplied by the factor 1·11. Now, let us write C_1 for the normal amount in any one circuit, and C for the whole current furnished by the machine. Clearly $\mathrm{C} = \mathrm{C}_1 \times c$. Multiply both sides of equation (1) by this quantity and we get an expression for the normal output in watts, which we may arrange as follows:—

$$\mathrm{E\,C} = n \times \mathrm{C}_1 \mathrm{Z} \times p\,\mathrm{N} \div 10^8. \quad \ldots \quad \ldots \quad (2)$$

The quantity $\mathrm{C}_1\mathrm{Z}$ is the whole loading of current upon the periphery of the armature, irrespective of the direction of the current. If the current density in the copper is assumed constant, the loading is proportional to the whole cross-section of copper in the transverse section of the machine. The quantity $p\,\mathrm{N}$ is the magnetic loading, or, in other words, the whole number of magnetic lines that crosses the air-gap from all the poles, irrespective of the direction of the flux across the gap. It is proportional, if the flux density in the gap is assumed at a constant mean value, to the total pole-face area around the machine, or, roughly, is proportional to the quantity of iron in the machine. Hence we see that our formula gives us the information that the output is proportional to engine speed, to total cross-section of copper, and to total pole-area of iron. Further, be it remarked that in ordinary continuous-current generators for electric lighting, while n, the revolutions per second, is a quantity of the order of from 2 to 12; the quantity $\mathrm{C}_1\mathrm{Z}$ is of the order of 1,000 to 100,000; while the quantity $p\mathrm{N}$ is of the order of magnitude from 1,000,000 to 100,000,000. If we are considering the causes of limitation to output we are at once met with the engine problem as limiting n, while as to the two other quantities, it is found from experience, at least so far as continuous-current machines go, that satisfactory performance cannot be obtained* unless the latter is about 1,000 times as great, numerically, as the former. There is another limitation in the above formula—namely, a limitation to the product $n\,p$, for half $n\,p$ is the frequency of magnetisation of the armature iron as it passes the poles. This is, of course, a prescribed quantity in the case of alternators, being usually 50 for lighting machines or 25 for power generators; so that $n\,p$ must be either 100 or else 50. In the case of continuous-current machines, designers usually keep down either n or p, so that the product np shall not be more than 40 (often under 40), so as to keep down the energy losses in the iron of the core and teeth.

There is a mode of regarding the design of electric generators which is originally due to Mr. H. A. Mavor,† and which employs the conception of the "active belt." If we regard any modern generator, whether for continuous or alternating currents, we observe that there is a large portion of the machine which is motionless and another large portion which, though moving, is electro-magnetically inert. The whole of the electro-magnetic actions occur in a very narrow belt of the armature, namely, in that annular portion of space where the copper conductors are cutting across the magnetic lines. It is a peripheral belt of the armature extending in width through the core from front to back, and in depth to the bottom of the slots. If the diameter of the armature at the face be d, the core-length from front to back l, and the depth of the slots s, then the volume of this *active belt* will be $\pi\,(d \pm s) \times l \times s$; the + sign applying to the case of stationary external armatures, the − sign to rotating internal armatures. In large machines where s is small compared with d, the volume is approximately equal to $\pi\,d\,l\,s$. Of this volume, part is occupied by iron teeth through which the magnetic fluxes traverse the belt radially; part consists of copper through which the electric currents flow parallel to the shaft; and part consists of inert insulation, some of which surrounds the copper, and some lies between the laminations of iron. If we consider the annular flanking surface of this belt, of area approximately $\pi\,d\,s$, there passes through this area the whole current loading, which we have called $\mathrm{C}_1\,\mathrm{Z}$. If we divide this by the area we shall obtain an expression for the mean gross current density through the active belt, which we may write—

$$\acute{a} = \mathrm{C}_1\,\mathrm{Z} \div \pi\,d\,s.$$

If next we consider the principal surface $\pi\,d\,l$ of the belt, and remember that through this there enters the integral magnetic loading $p\,\mathrm{N}$, we can similarly find the mean gross magnetic density in the active belt as—

$$\beta' = p\,\mathrm{N} \div \pi\,d.$$

Now, returning to our equation (2), let us substitute for the three factors on the right hand their respective values,

$$n = \acute{v} \div \pi\,d,$$

where $\acute{v}$ is the peripheral speed in inches per second—

$$\mathrm{C}_1\,\mathrm{Z} = \acute{a}\,\pi\,d\,s$$
$$p\,\mathrm{N} = \beta'\,\pi\,d\,l,$$

and we obtain at once

$$\mathrm{E\,C} = \frac{\acute{v}}{\pi\,d} \times \acute{a}\,\pi\,d\,s \times \beta'\,\pi\,d\,l \times 10^8,$$

whence, dividing down by $\pi\,d\,l\,s$, we get as the number of *watts per cubic inch of active belt* the value—

$$\frac{\mathrm{E\,C}}{\pi\,d\,l\,s} = \acute{v} \times \acute{a} \times \beta' \div 10^8.$$

In other words, the specific utilisation of the materials of the active belt depends on three factors only (apart from the numeric 10^8), namely, the *peripheral speed*, the *gross electric density* and the *gross magnetic density*. We may call these the *three factors of specific utilisation of materials*.

Now, as it is clearly to the interest of the manufacturer to use as little material as possible for getting the prescribed output, it is clear that he ought to aim at having as few cubic inches as possible per kilowatt of output, or getting as many watts of output as possible per cubic inch of active material.

In the course of the last few years I have examined the data of a very large number of machines to ascertain the value of their constants, and in particular of these factors of utilisation. In the case of continuous-current machines the values of $\acute{v}$ lie mostly between 400 and 900 in. per second (*i.e.*, between 2,000 and 4,500 ft. per minute); those of $\acute{a}$, between 300 and 460 amperes per sq. in. gross; those of β', between 30,000 and 45,000 lines per sq. in. gross. The watts per cb. in. of active belt run from about 45 to 120.

In the case of alternators of ordinary pattern, the values run somewhat differently. The difficulty of constructing machines with revolving armatures with a sufficiently high peripheral speed to give a wide enough pole-pitch, together with the greater ease of insulating stationary structures, has led to the preference for the type with rotating magnet-wheel. And, with the adoption of edge-wise strip winding on the poles, higher peripheral speeds have been possible, so that the usual values of $\acute{v}$ run from 1,000 to 1,400 in. per second (*i.e.*, 5,000 to 7,000 ft. per minute). But owing to the necessity of avoiding too great armature reaction, $\acute{a}$ seldom reaches 400, and is more usually between 220 and 300 amperes per sq. in. gross; while the value of β' cannot well be pushed beyond 30,000, and in 50-cycle machines is seldom carried beyond 24,000 or 25,000 lines per sq. in. gross.

In reflecting on these figures it must be borne in mind that these are not the net densities. Suppose that in any machine the teeth

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* The argument is as follows:—Let the pole pitch be denominated τ, the pole span b, the length from point to back of the pole-face l, the ratio of b to τ be called ψ, the specific loading of the armature (ampere-conductors per inch peripheral) q, and the flux-density (mean) at the pole-face B; then—

$$\frac{p\,\mathrm{N}}{\mathrm{C}_1\,\mathrm{Z}} = \frac{\mathrm{B}\,b\,\mathrm{L}}{q\,\tau} = \frac{\mathrm{B}\,l}{q}.$$

Now the value of ψ is about 0·75, while the machine will not be satisfactory as to heating, distortions and commutation unless q is not greater than 660, and l than 16, nor unless B is about 55,000 (all these in inch units). Hence the above ratio is about 1,000.

† "Journal Institution of Electrical Engineers," XXXI, p. 218, 1901.

and slots are of equal breadth, and that of the total area of slot one-half is taken up by insulation and packing, then though the true current density in the copper may be 2,000 amperes per sq. in. of section, this will be only 500 amperes per sq. in. gross; and if in the iron the true flux density is 100,000 lines per sq. in., yet if the pole covers only 0·7 of the pole pitch, and if the slots take up equal width with teeth, and if 15 per cent. of the total armature core-length is taken up by ventilating ducts and insulation, then the β' will be only 30,000 lines per sq. in. gross.

It is therefore obviously important to use such dispositions that the space factor of the copper in the slot can be as high as possible consistently with adequate insulation. Round copper wires are to be avoided. They take up just as much useful space as square wires, and have only 0·7854 conductance. The substitution of square —or rectangular—wires for round wire is equivalent to the discovery of a new metal having a conductivity of 127 per cent. as compared with copper. Let us write σ_1 for the copper space-factor in the slots and σ_2 for the iron space-factor in the teeth, ζ for the ratio of slot-breadth to slot-pitch, and $1-\zeta$ for the ratio of tooth-breadth to tooth-pitch.

Then $$a = a\,\zeta\,\sigma_1, \text{ and } \beta' = B_t\,\psi\,(1-\zeta)\,\sigma_2,$$

where B_t is the mean flux-density in the teeth, so that the equation of utilisation becomes—

$$\frac{E\,C}{\pi\,d\,l\,s} = v \times a\,\zeta\,\sigma_2 \times B_t\,\psi\,(1-\zeta)\,\sigma_2 \div 10^8 \quad \ldots \quad \ldots \quad (4)$$

in which form appear the real current density and the real flux-density on which mainly depend the armature losses and the heating. Now the product of ζ into $(1-\zeta)$ will be a maximum if $\zeta = 0{\cdot}5$, that is to say, other things being equal, the specific utilisation will be highest if tooth and slot are each of equal breadth, a condition mostly reached in tramway generators. The copper space-factor σ_1 usually lies between 0·4 and 0·6 in large tramway generators. It may reach 0·7 or even 0·75 in low-voltage machines. In alternators at 2,000 to 3,000 volts it varies between 0·25 and 0·35. In those at 1,000 volts it varies between 0·06 and 0·2. The iron

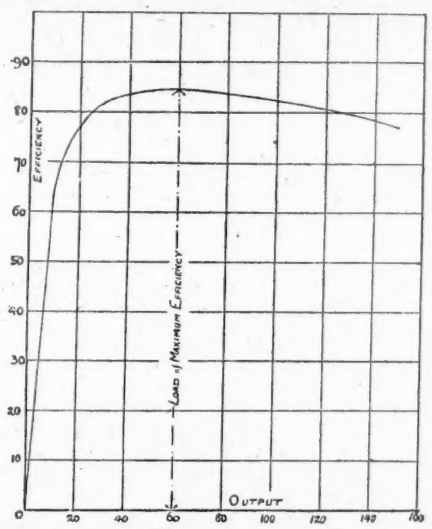

Fig. 1.—Curve of Efficiency at Different Outputs.

space-factor σ_2 depends partly on insulation and partly on the space taken up by air-ducts. If the laminations are 20 mils thick, insulated with a thin paper sheet, and if there are no air-ducts, σ_2 may be as high as 0·92 or 0·93; but good ventilation necessitates air-ducts, and in modern machines the air-ducts may take up from 15 to 20 per cent. of the available iron-section, making σ_2 from 0·74 to 0·80.

We are here face to face with the possibilities of making the highest use of our materials. Peripheral speed costs nothing, *per se*; but it involves the strength of materials, and a design that affords adequate strength in its mechanical parts. With the adoption of toothed cores, which I have advocated consistently from the date of my Cantor Lectures here in 1883, the use of higher peripheral speeds has been made possible. The core bodies being built up of laminated steel, are also now safely driven at speeds impossible formerly. It is probable that the future will see a further development in this direction. The change in design in continuous current generators from the early bipolar and multipolar types to those of more recent date (as exemplified particularly in the Berlin stations) illustrates this attainment of higher specific utilisation by higher peripheral speeds, and a type of armature more nearly approaching a fly-wheel in design.

In examining equation (4) we see that specific utilisation is augmented by using high densities of magnetism in the teeth. This, of course, involves heating since the hysteresis losses go in proportion to $B^{1\cdot6}$ and the eddy-current losses in proportion to B^2. On the other hand, the specific utilisation is augmented by using high current densities in the copper, and the losses are proportional to a^2. In either case, the attempt to exact the utmost specific utilisation of material involves a lowering of the running efficiency; while the attempt to attain the utmost efficiency implies the adoption of a low specific utilisation. But it must not be forgotten that the losses due to iron (which we may take as approximately proportional to B^2) are practically constant at all loads, while the losses due to copper resistance (which are approximately proportional to a^2, as the resistance rises only slightly with temperature rise) are distinctly load losses.

This brings us to the question of efficiency, the ratio of output to input. If we write η for the efficiency, x for the load kilowatts, a for the no-load losses which are practically constant or rise only very slightly with the load, then the equation of efficiency is:—

$$\eta = \frac{x}{a + b\,x + c\,x^2}$$

where b is a quantity that is of the order of 1·02. The coefficient c depends chiefly on the copper resistance, and is nearly constant. The curve of efficiency plotted from this equation shows the following features. For $x = o$, $\eta = o$. For small values of x, such that x and $c\,x^2$ are both small compared with a, the equation is $\eta = x/a$, which gives the asymptote to the first part of the curve. Then it takes the approximate value $\eta = \frac{x}{a+x}$. When the load is such that $c\,x^2 = a$, or $x = \sqrt{a \div c}$, η becomes a maximum. Finally, if x is great relatively to a, the equation becomes approximately $\eta = 1 \div (1 + c\,x)$.

It is generally recognised by engineers that the efficiency is a maximum at that point when the load losses and no-load losses are equal. The adoption of high current densities in the copper for machines that are for but a small part of their working hours working at their rated maximum load is here justified.

All the foregoing considerations have been directed to the utilisation of materials in the active belt. But this is only a portion of the whole materials of the machine. Indeed, the total weight of the generator is from 12 to 25 times the weight of the material in the active belt. Mr. Mavor has kindly supplied me with some data of his continuous-current generators, from which it appears that the iron in the belt is from 23 to 32 per cent. of the armature iron (in many machines it is smaller), while the copper in the belt is from 33 to 43 per cent. of the armature copper. In large alternators the armature copper is from $\frac{1}{3}$ to $\frac{1}{2}$ that of the copper on the field-magnets, the most usual proportion being $\frac{1}{4}$. But as the "active" copper is usually only some 40 per cent. of the whole armature, it follows that the inactive copper on such machines is some eight or ten times as great as the active copper. Clearly, then, it does not do to push the sole consideration ot the active belt too far; nor to forget that many of the points as to increased specific utilisation are equally applicable to the inactive parts, for example, the remarks about copper space-factor and the advantage of using square wire instead of round, apply equally to the winding of field magnets.

One broad fact stands out above all these considerations—the advantage gained by the adoption of a *high peripheral speed*; and this is the important consideration in the present regard.

Passing on to the question of design, it may be remarked that the last years have seen a very important development in the processes of designing, in the discovery and use of certain rational formulæ which, while based on first principles, and therefore true for all classes of machines by all different makers, contain certain factors or coefficients, the values of which are determined by experience. The first suggestion for such rational formulæ came in 1891* from W. B. Esson. They have gone through various stages of evolution, but resolve themselves into expressions in which the rated output is given in terms of the dimensions of the armature core or *vice versa*. If d be the diameter of the armature at the face, and l the length of the core parallel to the axis (both in inches), then the formulæ for output may be expressed either in terms of d^2 and l (that is proportional to the volume of the core) or in terms of d and l (that is proportional to the peripheral surface of the core). The former plan (due to Esson) involves the revolutions per minute. The latter (due to Steinmetz) does not, since it assumes an appropriate peripheral velocity. In applying the expressions to alternators the apparent kilowatts (that is, the kilovoltamperes) must be taken, not the net output, since the copper parts must be large enough to carry the actual amperes, whether in phase with the volts or not.

In their final forms these output equations are as follows:—

$$d^2\,l = \xi \times \frac{\text{KW.}}{\text{B.P.M.}}$$

$$d\,l = \beta \times \text{KW.}$$

Where the output coefficients ξ and β have the following values:—

Continuous-Current Generators.

(Esson) $$\xi = \frac{60{\cdot}8 \times 10^{10}}{B_g \times q \times \psi};$$

(Steinmetz) $$\beta = \frac{15{\cdot}9 \times 10^{10}}{B_g \times q \times \psi \times v}.$$

In these formulæ B_g stands for the density of the flux in the gap, considered as uniform over the ideal pole surface; q the specific electric loading, or number of amperes carried per linear inch of the periphery; ψ the ratio of the equivalent pole-span to the pole-pitch; v the peripheral speed in feet per minute.

* "Journal Inst. Electrical Engineers, XX, p. 272, April, 1891.

The coefficients ξ and β are connected by the relation:—

$$\beta = \xi \times \frac{1}{d \times \text{B.P.M.}} = \xi \times \frac{\pi}{12\,v}.$$

Alternate Current Generators.

(Esson) $$\xi = \frac{60{\cdot}8 \times 10^{10}}{\kappa \times B_g \times q \times \psi};$$

(Steinmetz) $$\beta = \frac{15{\cdot}9 \times 10^{10}}{\kappa \times B_g \times q \times \psi};$$

Where κ is a coefficient worth about 1·11, depending on the form-factor of the magnetic distribution, and on the distribution or concentration of the armature windings in slots.

The pole-pitch τ of alternators depends only on the peripheral speed v, and on the frequency f. If v is expressed in feet per minute, and f in cycles per second, then the value of τ in inches is given by the formula:—

$$\tau = \frac{v}{10\,f}.$$

This relation has the result that if the foundation wheel of the revolving field-magnet structure is of cast-iron, since the appropriate safe peripheral speed for the magnet poles is about 5,000 ft. per minute, the pole-pitch will be about 10 in. for alternators of the normal frequency of 50 cycles per second, or 20 in. for the less usual frequency of 25 cycles per second. For field-magnet systems built of steel laminations or of solid compressed steel, higher peripheral speeds are safe, and the pole-pitch becomes correspondingly greater.

Another rational formula of great value in determining the size of frames, since it fixes the total flux from all the poles, is given by the expression—

$$p\,\text{N} = \frac{\text{K.V.A.}}{v \times q} \times 445{,}000 \times 10^6$$

where p is the number of poles, N the flux from any one pole, K.V.A. the output in kilovoltamperes, and v and q have the same meanings as above.

The formulæ given above are all *rational*. Those for continuous-current generators can be easily deduced from the following four expressions:—

1. Electromotive force generated.

$$\text{E} = \frac{p}{c} \times \frac{\text{B.P.M.}}{60} \times \text{z} \times \text{N} \div 10^8;$$

where c is the number of circuits in parallel through the armature, and z the number of armature conductors (total), in the slots.

2. Number of armature conductors.

$$z = q \times \pi \times d \times c \div \text{C};$$

where C is the whole current at full load. This formula is a consequence from the definition of the specific electric loading, q, as the number of amperes per inch of the periphery; for each conductor carries $\text{C} \div c$ amperes, and the periphery is $\pi \times d$, whence $q = \text{z C} \div \pi\, d\, c$.

3. Flux per pole.

$$\text{N} = B_g \times d \times \pi \times \psi \times l \div p;$$

for the pole face area is equal to the pole-span $d\,\pi\,\psi \div p$ multiplied by l, and multiplying this by the mean flux-density over the area gives the flux.

4. Output in kilowatts.

$$\text{K W} = \text{E} \times \text{C} \div 1{,}000.$$

An example of the use of such formulæ may be given by way of illustration. Let it be required to find the principal dimensions d and l for a continuous-current generator to give 160 amperes at 250 volts, to run at 300 B.P.M. This will be a 400-K.W. machine. Experience shows that for such a machine appropriate values of the constants will be: $B_g = 55{,}000$; $q = 600$; $\psi = 0{\cdot}75$; $v = 3{,}600$. Hence the Esson coefficient will be

$$\xi = \frac{60{\cdot}8 \times 10^{10}}{55{,}000 \times 600 \times 0{\cdot}75} = 24{,}600$$

$$d^2 l = 24{,}600 \times \frac{400}{300} = 32{,}800.$$

$$\text{Now } d = \frac{12 \times v}{\pi \times \text{B.P.M.}} = \frac{12 \times 3{,}600}{\pi \times 300} = 45{\cdot}7 \text{ in.}$$

$$\text{So } l = \frac{32{,}800}{45{\cdot}7 \times 45{\cdot}7} = 15{\cdot}7 \text{ in.}$$

Now the advantage of rational formulæ such as these is this:—That, taking as a basis of experience a few machines which have been found to work well, and deducing from their dimensions and performance the values of the constants B_g, q, ψ, and v, those same constants can be used to design other machines of different outputs and speeds, with the absolute certainty that when constructed their performance will be such as to fulfil the prescribed specification. The output formulæ give a direct means of starting with the proper dimensions. They do not, it is true, afford an immediate solution to the question of the cheapest machine, for whether we use the $d^2 l$ or the $d\,l$ formula, choice is still left as to the particular values of d and l which will meet the case. That is to say, the formula furnishes the designer with a number of *primâ facie* designs, each of which will fulfil the specification, and amongst these he must subsequently select the one which, under the existing conditions of cost of materials and labour and of the organisation of his factory, will be the cheapest to construct. On the question of design in relation to manufacturing costs, several most valuable papers have been published by Mr. Hobart,* whose experience as a designer has been probably as extensive as that of any other engineer. One may use either the $d^2 l$ formula or the $d\,l$ formula as a basis, but I am disposed to the view that while the former is more suitable for designing continuous-current generators, the latter is preferable for alternators. For in the case of continuous-current designs, the dominant question is sparkless commutation, not heating, nor regulation, and surface speed is a secondary consideration; whereas in ordinary alternators smallness of voltage drop is the dominant question, and the surface speed is vastly important as it governs the pole-pitch.

(To be continued.)

CORRESPONDENCE.

Letters received by us after* 5 p.m. on Tuesday *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Cost of Living in the South American Republics.

(By One who has had Experience There.)

Having received numerous letters asking for the cost of living in South America, I have come to the conclusion that the best way to answer is through the columns of the Electrical Review.

There seems to be an idea that one can live in South America at nearly the same cost as in England; but in this there is a great mistake, paper being used instead of gold, and the rate of exchange varies from day to day. I will give a few prices, which will show the cost of living, if one wishes to uphold his position, and in this country everyone is expected to do this.

The first question which is asked by most of those who write me is—What is the cost of lodgings and food? A room (not furnished like one in England), with coffee and bread in the morning and dinner at night, costs from £9 to £15 per month. Breakfast, which is served at about noon, usually costs about £5 per month. Total cost, from £14 to £20 in all.

Clothes are a very expensive necessity. A suit which could be bought in England for £3 10s., costs from £7 to £10, and is not a good fit such as one might expect for the price. The continual change of climate necessitates at least four suits a year, also an overcoat, which will cost from £7 to £12. Shoes which can be bought in England for 15s., cost £1 10s. to £2, and the sandy soil wears them away very fast. If one wishes to enjoy a smoke, he will pay 2s. for a cigar, and tobacco will cost from 10s. to 18s. a pound. Other expenses are just as high, and if one is married he will pay about £15 a month for a house containing five or six rooms.

One question asked is, Could I live on £400 a year? I would not advise any engineer or manager to accept a salary of less than £600 per year, and then he could not save much money. The price of everything is going up, and there is no knowing when it will stop. A man obtains a situation in England, and thinks a salary of £400 a year very large; but I can tell you that £150 in England is as good, if not better, than £400 in South America.

I am frequently called upon by men who come out here on "spec.," and not finding work are on the verge of starvation. I may cite the case of one man who came out here with £150, and were it not for help obtained by subscription, he would never have seen old England again. Another point is that one must speak the language of the country (Spanish and Portuguese) as English is only spoken when absolutely necessary, which is seldom.

* "Electric Motors," Whittaker & Co., 1905. "Electrical Magazine," August, 1905. "Method of Designing Induction Motors," St. Louis Congress, 1904. "Journal Institute Electrical Engineers," XXXVI., p. 374.

I hope this letter will satisfy those who have written me, and also others who are in want of information regarding South America.

English.

Buenos Ayres, *September 27th*, 1906.

[We are indebted to our correspondent for his interesting letter, and should be glad to receive similar information from other countries for the guidance of readers who may be meditating emigration.—Eds. E.R.]

Twin Lead-Covered Wiring.

Mr. H. B. Maxwell, in his letter *re* the above, asks your permission to explain for the benefit of your readers the superiority of the twin lead-covered wire system, with the make believe that the idea was his own.

Hundreds of pounds worth of twin-wire lead tube system (which is that of the late Mr. R. F. Yorke, M.I.E.E.) was done in Partick before Mr. Maxwell arrived, which he at once condemned, giving it a serious set-back, but as it has stood the test of over 10 years, with all the dangers of contact with gas-pipes, damp, nails, &c., I suppose Mr. Maxwell has now become a convert to the lead system.

Mr. Maxwell tells us lead-covered wires should always be run on the surface and looped—this seems to be as far as his confidence goes in electric work and workmen—such opinions as these have been the ruin of the trade as a profession. The work is now played as much as possible into the hands of the unskilled workman and boy labour, so that journeymen are suffering very severely. Twenty years ago workmen were trained in concealed wiring, perfect jointing, &c.; such work at the present day is pointed to as samples of perfection and confidence.

I often wonder what would happen to the gas fitter or plumber who would propose that all his pipes must be brought to the back of the brackets, and water cranes to be looped—and that they should all be run on the surface—he would certainly be put into an asylum.

Mr. Maxwell proposes to cover the twin lead-covered wires behind plaster, with lengths of Simplex tubes, coated after erection with tar or other cheap preservative. How is he going to coat or preserve the inside of the tubes next the wires? Practical experience with users of iron and steel tubes is that corrosion begins in the inside of the tubes as well as the outside—until it gradually closes the interior up—and in time will penetrate the insulation of the wires, and they can never be pulled out or got at.

Steel is not to be compared with lead for a lasting protection for electric wires, and many engineers know it and confess it, but steel is boomed by a syndicate spread all over the country—that is the great barrier to the lead or other systems.

I am of the same opinion as the late Mr. Yorke that the day will come when tin lead will be the only allowable system.

David McGibbon.

Partick, *October 16th*, 1906.

I shall be glad if you can afford me the space in your paper to reply to Mr. H. B. Maxwell's letter on the above subject in your issue of October 12th.

The use of three and four-plate ceiling roses as suggested by Mr. Maxwell is certainly delightfully simple, but such a method fails to provide the most essential detail, namely, a convenient and effective means of rendering the lead sheathing metallically continuous for the purpose of earthing. If lead-covered wire may be run in roof joists, why not in the centre line of floor joists as I suggested? It is just as much out of harm's way.

With regard to walls, I go further than Mr. Maxwell, and say lead-covered wire should never be "laid in plaster or cement," but laid in a chase cut in the brickwork and covered with hoop steel to keep the plaster or cement from contact with it.

As to cheapness, undoubtedly ceiling roses are cheaper than the joint boxes; but, as they do not fulfil the same functions, the comparison is not a fair one—at any rate, I think it can hardly be claimed that "split steel tube bushed" is cheaper than hoop steel.

I think Mr. Maxwell, in drawing his conclusions about the joint box, has been a little misled by the illustration. The box is fitted with the pillar type of terminal, which he describes as being so superior. I sent one of the joint boxes to Faraday House to be tested, and in the report it states that a pressure of 10,000 volts was applied before sparking took place between opposite poles across the surface of the porcelain, and that the box, beyond being perceptibly warm, was found to be uninjured. The saddles are now being slotted in the top and tinned, so that they may be soldered to the lead sheathing, clamping being no longer depended upon for securing contact. The earth plate is also being tinned to protect it from corrosion.

E. L. Berry.

London, W.C., *October 22nd*, 1906.

The Double-flow Steam Turbine.

In your issue of the 12th inst. is a communicated article on the double-flow steam turbine, which is deservedly praised by the writer as possessing features in mechanical design far superior to the single-flow Parsons type. It is unnecessary to go into these particular advantages here, but what appeals to me in the first place is the lack of full knowledge displayed in the account of the accident to one of these turbines through faulty operation of the condensing plant.

In the first place, the only firm manufacturing a double-flow turbine in this country is the British Westinghouse Electric and Manufacturing Co., Manchester; and secondly, the only station out of the many supplied with this turbine where an accident has occurred due to faulty operation of condensing plant, viz., the cause pointed out by the writer, is the Underground Electric Railway Co.'s station at Lot's Road, Chelsea, where eight 5,500-kw. turbo-generators are installed. This being so, it is necessary, in justice to this particular design, to point out that it was due to no inherent fault of the turbine, but entirely to the arrangement of exhaust valves and piping, which were neither designed nor supplied by the British Westinghouse Co. The turbine exhausts at each end into a vertical condenser as stated, each exhaust being provided with a sluice valve linked to the other with a driving chain. One valve, due to bad setting, lagged the other and allowed one end of the turbine to exhaust to the condenser at a fairly high vacuum, while the other exhausted to atmosphere. The difference in end pressure set up was fatal to this, as, indeed, it would be to any piece of similar machinery.

To prevent a recurrence a pipe was fitted connecting the two exhausts at a point between the turbine and valves, which was enough to prevent a similar accident, even though one valve was fully open, and the other closed. Since this "fool-proof" device was fitted, the trouble has been entirely eliminated.

Again, it is almost laughable to read in the article under discussion how little the writer understands his subject. He considers the case of a number of rows of blades being stripped on one side only, and says:—"The result would very often prove disastrous, the inequality of pressure set up being probably sufficient to damage the comparatively weak thrust block to such an extent as to cause further mishap." Although a "little knowledge is a dangerous thing," one would have supposed the writer to have studied his subject a little deeper. If he had, he would have found that the quantity of steam flowing into each side of the double-flow turbine was absolutely independent of the Parsons blades, in fact, if the Parsons blades were entirely out on one side, the quantity of steam flowing into that side would remain the same; this is due to the fact that the steam is admitted through nozzles, the terminal pressure of which is less than ·58 of the initial pressure. We can only presume that the "inequality of pressure" which is going to be so "disastrous," is the outcome of a vague idea that were some of the first Parsons blades, which are short, stripped, the subsequent rows of longer Parsons blades would present a larger area to the steam. They would, but the pressure would drop in proportion, so the conditions would remain practically as they were before, and no undue thrust would be experienced.

Trusting you will find space in your columns for this repudiation of an unjustifiable criticism of a type of turbine rapidly becoming popular.

Onlooker.

[Surely "Onlooker" is inconsistent; he says first that the double-flow turbine is "deservedly praised" by the writer, and winds up by repudiating the "unjustifiable criticism." He retells the tale of a disaster to a turbine, without adding any new information, and endorses the writer's explanation of the means adopted to prevent a recurrence. He then ridicules the writer's remarks on the double-flow turbine—who said anything about the Westinghouse type? Mr. Parsons used it years ago—and applying them to a particular type, labours to prove them inapplicable. But the fact remains that in the Parsons double-flow turbine, stripping of blades in one half will upset the balance of end pressures.—Eds. E.R.]

Cost of Suction Gas Power.

I cannot say that you have always treated me with the respect and consideration to which I think I am entitled. At the same time, to give the devil his due, I fail to see that you have been in any way unfair to the suction gas plant, or in any way biased against it, or unmindful of its advantages. I am somewhat surprised at the attitude taken up by the Campbell Gas Engine Co. It is unfortunate that almost all people who engage in the making and selling of a manufactured article are apt to assume the same intolerant attitude in respect of criticism. So long as the critic is saying things on the favourable side, the criticism goes down like melted butter, but the reception of the slightest adverse comment reminds one of the old woman who was passing hence and recounting the ledger balances of the little shop to her husband. So long as her feeble voice recounted "Mrs. Smith owes us 3s. 4d.," &c., he listened with patience, but when the credit was done with and she began to recount their debit balances, he stopped her promptly with, "Thee get on wi' thi deein' and leave them things to me."

T. a. V.

With reference to the "concrete example of 20 B.H.P. per hour for 1d.," contained in your issue of the 19th inst., we note that Mr. Campbell states that the test was carried out "under ordinary working conditions." On looking into the figures, however, we find that the said "working conditions" are represented by a load factor of 94 per cent. over a period of 6·75 hours!

We would respectfully ask Mr. Campbell for a "concrete example" of the results obtained with a similar engine averaged over a period of, say, 2,500 working hours, and with a load factor nearer 9·4 per cent. than 94 per cent.

Further—it is only a detail—the addition of the charges for capital, depreciation, maintenance, &c., would make the thing look more complete.

We hope that this will not be looked upon as either "unfair or partial criticism," but it pains us to see the fair fame of the suction gas plant sullied by even the slightest breath of misrepresentation.

H. R.

Edinburgh, *October 20th*, 1906.

Replying to your footnote to our letter in your last, we shall not complain of what you may publish bearing on the above subject if you will publish facts and publish them impartially. We do not, however, include the "communicated" article or your reference to the cost of coal in London as coming within the above category. They belong to the series of side-thrusts which it has been your practice to insert in your journal from time to time.

Whatever the journalistic practice may be with regard to communicated articles, the ordinary reader of your journal will take it that what is published by you, outside your "Correspondence" columns, has your general approval, and may be accepted as of value, or it would not be found in your journal, whereas the particular article in question is unfair and is extremely biased in its view.

With regard to the figures we sent you *re* "20-B.H.P.-hour for a penny," we are afraid you must be erroneously trying to read into them or infer from them something which isn't there. You say that our figures are absolutely unjustifiable; we shall be glad if you will explain this statement. The figures are quite clear to any power user, and are given in such a form as will enable him to compare them with similar data for other forms of power.

With regard to the figures in the paper you quoted, as we said in our last, we don't discuss them at present. The unit taken is one in which the suction gas plant is not commonly built to-day. We question whether there is a unit of this power working in this country at the present time, though there doubtless will be before long. It is the competition in the smaller units which has aroused the opposition to this power, and those smaller units of, say, 25 B.H.P. and upwards can be run on the more favourable fuel consumption figures quoted in that paper.

If a fair comparison is made in units of these sizes, the favourable results obtainable under ordinary working conditions from a suction gas plant stand out unmistakably as compared with any other power. We leave the larger unit to be dealt with when it is here.

The Campbell Gas Engine Co., Ltd.
Hugh Campbell.

Halifax, *October 22nd*, 1906.

[What is of value we approve; but we do not imagine that only what we approve is of value, and therefore we frequently publish articles which we think of value, but which express views with which we are not in agreement. Our correspondents plainly object to our publishing both sides of a question—yet they ask us to be impartial!

"Twenty B.H.P.-hours for a penny" is a misleading catch-phrase, which gives no clue whatever to the true cost, and, in fact, is pure nonsense. No man in this or any country can obtain 20 B.H.P.-hours for one penny. The phrase is a perfect example of suppression of the truth, suggestion of the false. We did not say the *figures* were at fault, but the *statement* above quoted.—Eds. E.R.]

The Penetrating Properties of the Arc Light.

I shall be glad if you will allow me a little space in which to reply to "Sol's" letter in your issue of the 12th inst.

In the first place, I must recommend "Sol" to read the paper by Tyndall on "The Blue Colour of the Sky," which was published in the *Proceedings* of the Royal Society, 1868-1869, and he will then find that, although the theory he has attempted to propound may account for the blue colour of the firmament, it cannot conceivably account for the blue colour of distant objects as seen through the lower strata of the atmosphere; because, as Tyndall points out, such lower strata cannot be conceived to contain unvaporised particles of water.

As I understand "Sol's" rendering of the theory, the atmosphere becomes more transparent the more solid particles it contains, instead of approaching, as most people would have thought, the opacity of a brick wall.

In an earlier letter I stated that I had already proved that the light from a 100-watt mercury arc penetrates a fog better than the light from a 500-watt open carbon arc, and none of "Sol's" theorising will explain away this fact.

C. Orme Bastian.

London, N.W., *October 22nd*, 1906.

Application of Magnetic Brakes.

Mr. A. B. Newell's observations *re* the above in this week's issue, and his summing up in the six notes, support my contention that the majority of accidents have been caused by locked wheels and consequent skidding, and although I believe the ordinary electro-magnetic track brake is satisfactory on systems where there are no severe gradients and where a car cannot accelerate to a dangerous degree even if skidding takes place, I am still inclined to think that from the standpoint of safety, on some tramway systems, it is desirable to energise the track brakes from the overhead wire

which may be easily accomplished from the ordinary controller by making the necessary connections from the braking contacts.

With respect to the proposed introduction of an automatic switch, I may say I have experimented in this direction for some years, and in 1901 I designed and patented an automatic switch which cut off the power supply and short-circuited the motors when a predetermined speed was attained (and which could be operated by hand at any time). It worked in a very satisfactory manner, but as the result depended entirely on the wheels revolving, and as it is now well known that at the critical time the wheels are not always revolving, the idea was dropped; and in my opinion, with track brakes designed for trolley excitation, there is no need for an automatic switch on the lines suggested by Mr. Newell, as the track brakes will then control the car even if the wheels are locked by the hand brakes.

H. E. Yerbury,
Chief Electrical Engineer.

Sheffield Corporation Tramways,
October 22nd, 1906.

Zone Patents.

I do not know what interest your readers can take, except, possibly, one of quiet amusement, in the question (deeply interesting to Mr. Joel) as to who is entitled to the credit which it appears is due to the inventor of the Zone machine. I should not myself go out of my way to claim any kudos, but when I see an attempt by Mr. Joel to "show his authority and right as the inventor of the Zone motor," whatever that authority may mean, I would ask you to grant me a space in which to put the true facts of the case before your readers.

In the first place, from the account and schedule of the Zone patents that Mr. Joel gives, it would appear that his patent is the chief one, and the others merely subsidiary ones, which the Zone Co. have not thought it worth while protecting abroad; as a matter of fact, my inventions have been patented in more foreign countries than Mr. Joel's, and represent three entirely distinct inventions. Only one patent of mine, No. 6,666, for small machines, was and could be in any way disputed by Mr. Joel, the principal Zone patents being quite unaffected by his patent. Mr. Joel bases his contention on the use in his specification of the term "Neutral Zone," and because he describes his field coil as "trending" in the direction of the armature winding. I do not know who originated the term "neutral zone," but it was certainly not Mr. Joel; and with regard to the other point, I do not know of any dynamo, except, possibly, the Lundell type, in which the field coil could not be described as "trending" in the direction of the armature winding. The whole thing depends on how and in what way the field coil "trends," and a reference to Mr. Joel's patent will show anyone that the interpretation he now seeks to place on the words is not borne out either by his description or by his drawings.

It is a little curious that, although Mr. Joel took out his patent in 1900, he did not attach any importance to the way in which the field coil "trended" until I was induced to join the Zone Patents Co., and explained to him personally the advantages as regards reduction in reactance voltage that I obtained by my system of winding. Even as late as January 13th, 1903 (the Zone Co. being formed in December, 1903), Mr. Joel read a paper before the Civil Engineers, in which he described his motor, and called it by the name "sine motor," on account of the sinuous shape of the field coil. Now that he sees the great success of my inventions, he calls his motor a Zone motor in order to reap credit which most certainly does not belong to him. As a matter of fact, any practical dynamo manufacturer would tell him that it is well-nigh, if not absolutely, impossible from constructional reasons, to make a Zone motor by his method. Certainly if by some chance it could be made, the result would be very different from anything shown in Mr. Joel's specification. The two things are quite distinct, Mr. Joel's patent being for a four-pole machine with only one coil, whereas I use four coils for a four-pole machine, six for a six-pole machine, and so on.

The only machine in which I use one coil is my two-pole under patent No. 6,666, which was the only one opposed by Mr. Joel, and in connection with this patent I was assured by those better qualified to judge than I am that if the case had come before the courts, as I now wish it had, it would most certainly have been decided in my favour, and that it would have been held that, to use the words of the Comptroller General: "The S coil claimed by the applicant (Mawdsley) is defined in his specification as presenting the feature of two straight portions parallel to the armature and is *not* a sinuous coil such as is described by Mr. Joel." The fact that a specific reference is made in a patent to another patent does not necessarily mean that they clash.

Mr. Joel quotes a description of the Zone system which appeared in your paper in 1904, but omits to say that the only figures he gave regarding reactance voltage were supplied by the writer of this letter, and that my late firm, Messrs. Newton's, of Taunton, supplied him with illustrations for that article. I may be sordid, but the interest I take in an invention of this nature, and the credit that I think attaches to the inventor, are more or less measured by the commercial possibilities of the invention, and as a shareholder in the Zone Patents Co. I can assure Mr. Joel that, when his motor brings into the coffers of that company even one-tenth of the royalties brought in by my machine, he will be welcome to all the credit that he likes to take, but until that desirable result is attained, I venture to say that your readers will be inclined to think that the writer who has spent years in designing machines under his own patents and in bringing the machine to its present pitch of perfection, is more entitled to whatever credit there may be in the inventing of the Zone machine than is Mr. Joel, the inventor of the Sine machine, who tries to claim that credit on the strength of an interpretation of a few words in a specification which is not supported by the drawings attached to the specification or by his own description of his invention.

H. St. Hill Mawdsley.

Taunton, *October 22nd*, 1906.

Rail Corrugations.

Mr. Boot in his letter in your issue of the 19th inst. states that, in his opinion, corrugations are due to the sparking of the return current. In your editorial footnote you ask about steam railways. Yes, but surely we need not go so far as steam railways, when on our own tramways we get corrugations on lengths of rail down hills where no power is consumed by the car. This, I think, easily disproves the sparking theory. On this section of tramways we are using solely regenerative cars, and we get corrugations in several places, chiefly when the cars either pull up or steady down to about eight miles per hour. Now the regenerative car is pulled up entirely without hand brakes, so that the vibration set up by brake blocks can have nothing to do with the trouble here.

Again, these corrugations occur not only on steam and electric lines, but on cable tramways, and here there is no tractive effort from the wheels, so that the theory of the single ended drive is put off. To my mind we are then brought to two common things on all lines, viz., whee's and rails, and if we consider the rails first, we find that the trouble occurs on railways with a flexible road bed, and also on tramways with a rigid bed; then on this line we have them on English rails laid in 1905, and on German rails laid in 1904, so that the trouble does not appear to rest either with the rolling mill or the road construction.

In one place here it is a difficult matter to find the rail joints; still the corrugations are there, but they commence in the centre of a rail and not at the joint, and continue for about 80 ft.

Now let us turn to wheels, and we find that we have the troubles on lines using exclusively cast-iron wheels, and also those using tired wheels, but in each case I think it will be found that if the wheels are gauged accurately after a little wear one wheel will be larger than the other, so that in running one wheel must slightly slip. I would suggest that this slipping action bears a definite relation to the speed and weight of the car, and only tends to produce the corrugations when these three items bear this relation to each other.

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If some of our traction engineers would give us their opinions, no doubt some solution to this mysterious trouble might be found.

H. Coxon.

Yardley, Birmingham,
October 22nd, 1906.

Gas.

I was much interested in reading your article last week, on page 651, regarding gas, and a friend of mine having handed me the enclosed circular from the Leamington and District Gas Fittings Co., brought it home still more forcibly. I think this circular might be interesting to you if you have not already seen it.

J. E. Teasdel,
Engineer and Manager.

Pontypridd, *October 22nd*, 1906.

[The circular is of the usual form, which has apparently been stereotyped by the gas interests, and supplied in bulk to the local companies ; it purports to show that electric lighting, at 5½d. per unit, costs 14 times as much as gas lighting, with gas at 2s. 6d. per 1,000 cubic ft.

An ounce of fact is worth a pound of theory ; our own actual experience has been that, under precisely similar conditions, gas lighting (largely incandescent) with gas at 2s. 10d. costs more than electric lighting, with carbon glow lamps, at 5d. per unit. This is based on the quarterly bills alone: the saving on redecoration, &c., is an additional gain, and, of course, the advantages of convenience and healthfulness are all on the side of electricity.—Eds. E.R.]

The Working of Foreign-owned Patents.

Mr. Byng's letter in your issue of the 19th inst., replying to your leader of the 12th on my article in the current number of the *National Review* on British Patent Laws is hardly what the occasion called for.

But the explanation given in your note on page 640 of the number for the 19th inst., showing that Mr. Byng was responsible for the estimates of 10 millions and 30 millions respectively mentioned in my article, and upon which you commented, sufficiently establishes my good faith, and I need not pursue that subject further.

If any error has been made, perhaps the kindest and justest extenuation is to be found in the fact that Mr. Byng's health has not for some time been such as to afford him time or opportunity for careful research.

If Mr. Byng has unwittingly given an excessive estimate of the amount of trade lost to this country by the monopoly in telephone apparatus and appliances, that does not affect the principle I was contending for, although it is always most desirable to have accurate data given in advocating any principle. Whether the amount of trade was £300,000 or £30,000,000, the principle remains unaffected.

The main purpose of my article was to call attention to a principle—which in your leader of the 12th inst. hardly received the attention it deserved—namely, the unfair operation of our Patent Laws, and the extent to which British manufacturers are handicapped. The justice of this principle, which for years I have been striving to establish, has been unanimously affirmed at annual conferences of the Associated Chambers of Commerce ; and, as the President of the Board of Trade, Mr. Lloyd-George, has now accepted it, and has promised, on behalf of the Government, to introduce a Bill next Session to meet the wishes of the Associated Chambers, I am quite content to await the issue of events.

The proposal has already been endorsed by public men of all sections of Parliamentary life, and when the Government introduces the Bill, I do not anticipate that it will meet with anything but a friendly and cordial reception.

I see nothing to object to in the argument which you quote from the *Quarterly Review*, of 1859. Most of our troubles, however, with foreign manufactures arising from patents have only come acutely to the front within the last 20 or 30 years, so that the writer in the year 1859 is somewhat out of date, and could have been hardly aware of the disabilities under which British manufacturers labour to-day.

There is only one minor point in your article which calls for a passing word of notice, and that is your method of measuring the amount of money spent in labour and materials. To gauge that amount by the amount of capital of a company seems to me somewhat fallacious, because many undertakings or private firms with £50,000 of capital, and good credit, do a turn-over of half-a-million in a year.

It is needless to observe, as I have already shown you evidence on the point, that I have endeavoured in this matter to obtain information from all sides, and I had no partiality for any particular set of figures, nor had I any desire to make any reflections upon the National Telephone Co., many of whose directors and chief officials are my personal friends, and are most honourable men in every walk of life.

Joseph Lawrence.

London, E.C., *October 23rd*, 1906.

[Sir Joseph Lawrence must have given a somewhat cursory glance at our leader. So far as that portion of his *National Review* article—which hardly received the attention it deserved—is concerned, we specially mentioned that the wider question must be left for a subsequent occasion. The occasion has arrived, and the question is fully dealt with in another column. Our quotations from the writer in the year 1859, related to points of justice and expediency, which we remarked, could never be "out of date."

As to the minor point which calls for a passing word of notice, we would ask whether Sir Joseph, as an astute man of business, is really serious in placing the National Telephone Co. and the General Post Office in the category of merchants. The N.T.C. and the G.P.O. are users, and their capitals are not employed in the way he suggests.—Eds. E.R.]

OUR LEGAL QUERY COLUMN.

[Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer.]

No. 57.—Builder's Contract—Sub-Contract for Electric Fittings—Sub-Contractor's Right to Sue Principal.

"Electric" writes:—"Could you advise me on the following? :—A householder called in a builder to do some repairs, including alterations to the electric light and new fittings. As to the later portion he called me in, and gave me the necessary instructions ; but on completion he said he thought the householder was likely to fail and would I send my account to her direct, reserving him 10 per cent. commission, and by his verbal direction I did so. At first she said she did not know me as she gave the whole of the work to the builder, but afterwards said she would pay. Now she has gone into bankruptcy, and the builder on my rendering the account to him refuses to pay, as he says he is not now liable for the debt. I should be glad if you could advise me through the E.R. if I can sue him. He gave the orders to me or my workman verbally, or if she gave an order to my men she understood it was the builder's men."

*** The short point is whether the sub-contractor has or has not elected to look to the principal for payment of his account. If he has done so, then his remedy is against the estate of the principal who appears to have become bankrupt. It would seem, however, that upon the facts, as stated, "Electric" is entitled to proceed against the person who directly employed him, namely, the builder. So far as can be gathered from the statement of facts there is no binding contract between "Electric" and the principal, for when he first entered upon the job, "Electric" appears to have looked only to the builder. If "Electric" thinks of making a claim against the builder he should consult a solicitor. The following authorities may be referred to :—Bowstrad's Digest of the Law of Agency (1898), Art. 41 (p. 105); New Zealand and Australian Land Co. *v.* Watson (1881), 7 Q.B.D. 374; Holts *v.* Turner, 18, T.L.R. 235.

Canals and Waterways.—The Royal Commission on this subject removed to Belfast, and received evidence on the condition and working of the canals in the neighbourhood, afterwards resuming its work in Dublin last week.

LEGAL.

BROOK *v.* CHATWOOD.

IN this case which was heard at Salford last week, plaintiff, A. B. Brook, an electrical engineer, claimed damages from Arthur B. Chatwood for alleged breach of contract. According to a report in the *Manchester Courier*, plaintiff alleged that defendant in 1904 agreed to employ him for a period of three years at a salary of 150 guineas per annum, and that the latter subsequently broke his part of the contract. On the other hand, the defendant pleaded that two months after the contract was entered into the parties agreed to rescind it, and that Mr. Brook then entered into the service of the Goodfellow Engineering Co., Ltd., then trading in Manchester. According to the plaintiff, Mr. Chatwood was a director of the concern, and after the wages had been paid by him for about four months, for the sake of convenience he suggested to his co-directors that it would be as well to pay the plaintiff's salary by cheque drawn on the company, because he was more in the service of the company. He acquainted Brook with the arrangement, and at the same time intimated that it would not alter the relationship that had existed between them, and that the latter would remain in his service. Later, plaintiff was dismissed at a fortnight's notice by the Receiver of the company. He denied emphatically that he had ever agreed to the transference of his services to the company.

The defendant gave evidence, and said that though there was no formal transfer there was, in fact, a transfer to the company of the plaintiff's services, and that the company started to pay him.

The jury found for the plaintiff, and awarded £38.

BUSINESS NOTES.

Electrical Exhibitions.—With the object of giving an impetus to the electrical development in the Twickenham and Teddington District, MESSRS. R. LANGSTON-JONES & Co., electrical engineers and contractors, of 34, High Street, Teddington, who are contractors to the T. and T. Electric Supply Co., Ltd., are holding an Electrical Exhibition at the New Pavilion, Kingston Road, Teddington, from October 30th to November 10th. For the education of householders, domestic appliances are to be shown in use, everything being plainly marked with the amount it costs to use per hour. The firm mentioned invite inquiries from those who have novelties, &c., that they would like to have on exhibition.

There is also to be an electrical exhibition in Brighton in January next.

L'Energique Accumulator.—Some weeks ago we published a few particulars of the battery lately put on the market by MESSRS. KRUPKA & JACOBY, and called "l'Energique." We have since examined a pair of cells of this type, and we now reproduce an illustration of a two-cell ignition battery, and a section through a single cell. The two outer plates, 1, 2, are positives, and consist of leaden grids filled with peroxide of lead, which is reduced

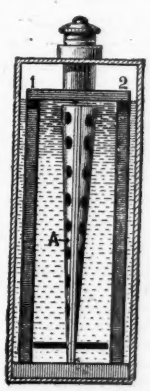


FIG. 1.—SECTION OF CELL.

in working and reoxidised by charging, in the ordinary way. The electrolyte is dilute sulphuric acid. The negative plate, A, consists of lead-antimony alloy, and is made in the form of a perforated pouch. The effect of charging the cell, while oxidising the positive plate, is merely to liberate hydrogen at the negative, which is unaltered. Even when the cell is fully charged, there is no P.D. between the poles, and short-circuiting the cell has no effect whatever. The plates remain unchanged apparently indefinitely, and the acid can be poured off, so that the cells can be transmitted by post or stored away with perfect safety. On filling the cell with dilute acid, no effect is produced; but directly a quantity of a compound containing cadmium is dropped into the negative plate, the cell becomes active, giving a P.D. of two volts, and continues to give out electricity until the compound is used up, when the pressure quickly falls to zero. A fresh charge of compound can then be inserted, restoring the cell to full activity. After a certain number of discharges, the positive plate becomes exhausted; the solution is then poured out, the interior of the cell washed with water, and fresh acid put in, after which the cell can be charged as before. No harm is done to the cell by a short-circuit while it is

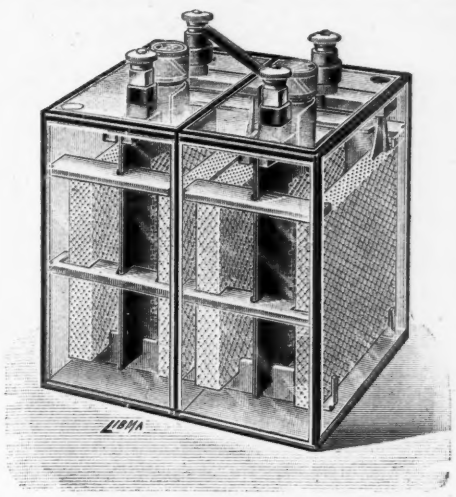


FIG. 2.—FOUR-VOLT IGNITION BATTERY.

charged, either with or without compound; in the former case, the discharge ceases directly the compound is used up; in the latter, nothing happens. A fixed quantity of compound being prescribed for each cell, the user always knows exactly what amount of electricity remains available by ascertaining the amount of compound in hand. The cells are made for ignition purposes, portable lamps, medical and X-ray apparatus, wireless telegraphy, &c., and compare favourably as regards both weight and cost with ordinary types.

Book Notices.—*Electric Bells, Indicators and Aerial Lines.* By U. Zeda. Translated by S. R. Bottone. London: Guilbert Pitman. Price 2s. net.—In these days the field of electrical engineering is so wide, and so much attention is being paid to what may be described as the heavy engineering side of the industry, that matters appertaining to the humble electric bell are apt to be overlooked, if not forgotten. If this little instrument happens to form an important part of a telephone or switchboard installation, it is given a passing interest. But the electric bell, pure and simple, seems to be somehow or other the particular speciality of the local "plumber, gasfitter and electrical engineer," and consequently it is doomed to comparative obscurity. This book, as a whole, should prove very useful to ironmongers, electrical fitters and others who are interested in electric bell work. It has an additional interest, inasmuch as it may be said to represent up-to-date Italian practice. There are a large number of connection diagrams throughout the volume, and many cuts illustrating the fittings put on the market by the author's firm, Messrs. Zeda Bros., of Milan. Bell practice in Italy seems to be very much the same as it is here in England. Nevertheless the Italians have introduced several novelties which may, in certain cases, be described as improvements, and to which considerable prominence is given. Chapter I is a description of the "apparatus necessary to the installation of electric bells," and contains a variety of diagrams and illustrations of bells, indicators and pushes. The second chapter is entitled "Batteries and the Electric Current." Mr. Zeda's explanations under this heading are not very clear, or else Mr. Bottone has been singularly unhappy in his translation. For example, take the following:—"The term battery actually indicates the production of electricity, as we understand it in the modern sense of the word," and in the next paragraph, "Returning to the battery we will endeavour to render clear the construction of a voltaic pair, its mode of action, the phenomena set up by it and its scope. But, first of all, let us ask ourselves, What is a battery?" The succeeding paragraphs do not give any intelligible answer to this question, but deal, on the other hand, with the question of current. "Current," we are told, "partakes of two qualities—electromotive force and quantity." In this way the author, having wrongly defined a battery at the outset, is made to ask himself the question, What is a battery? to which he is unable to give a satisfactory reply. Mr. Zeda does not extend his knowledge of electric bells to the kindred subject of electricity and magnetism. It is assumed in Chapter I that the reader has a sufficient knowledge of the latter subject, and we think that in future editions a large portion of Chapter II might well be omitted. The following section relates to the setting-up of electric bells, and contains a number of useful practical hints, together with a great variety of connection diagrams. The latter are quite clear, and cover almost every set of conditions that are likely to be met with in practice. The succeeding chapter is entitled "Useful Electrical Devices," and commences with the description of an instrument for use in mortuaries which will give notice of the slightest movement of a supposed corpse. A rapid descent is then made from the sublime to the ridiculous, and some electrically-driven roulette wheels, made

under the patent of a Mr. Alvieri, of Rome, are illustrated. It is to be feared that the Gaming Acts will prevent English engineers from developing a power load in this direction. The chapter concludes with a few hints relative to connecting bells on lighting circuits, and the remainder of this remarkable little booklet is devoted to descriptions and illustrations of porcelain insulators for aerial lines.

Messrs. Archibald Constable & Co. will shortly publish a large and important work on "Electric Railway Engineering," upon which its authors, Messrs. H. F. Parshall and H. M. Hobart, have for some considerable time been engaged. The work will treat exhaustively of the various systems in use, whilst the text will be accompanied by a large number of illustrations, tables, curves and diagrams.

"The Electric Theft." By N. W. Williams. London: Greening and Co., Ltd. 1906. 6s.

"The *Engineering* and Electric Traction Pocket-Book." By Philip Dawson. Fourth Edition, 1906. London: Offices of *Engineering*. 20s. net.

"High Frequency Currents: Their Production, Physical Properties, Physiological Effects, and Therapeutical Uses." By H. E. Crook. London: Baillière, Tindall & Cox. 1906. 7s. 6d. net.

"Transactions of the American Electro-chemical Society." Vol. IX, 1906. Philadelphia, Pa.: The Society, 39, South 10th Street.

"Fortschritte der Elektrotechnik." Vol. 19, Part 4, 1905. Berlin: Julius Springer.

"Journal of the Institution of Electrical Engineers." Vol. 37, No. 180. September, 1906. Index and "List of Officers and Members Corrected to August 31st, 1906." London: E. & F. N. Spon, Ltd.

"Red Books of the British Fire Prevention Committee, Nos. 114 and 116. Fire Tests with Floors and Fire Tests with Glass respectively. London: The Committee. 2s. 6d. each.

Electricity in Chinese Mines.—In their report just issued, the Chinese Engineering and Mining Co., Ltd., state that in order to facilitate the working of the mines and to provide for a large increase in the output, the board decided in the autumn of last year upon the erection of powerful electrical pumping and lighting plants at the Tongshan and Linsi mines. Contracts were entered into in November and January last for the supply of the requisite plant, which is now in course of erection, and the extensive buildings for the power stations are nearing completion. The contracts provide that the installations shall be in operation by the end of the present year.

New "Cone-Point" Patent Brush-holder.—The accompanying illustrations show a new type of brush-holder of original and ingenious design. Referring to fig. 2, the carbon brush B is provided with a metal cap ending in a conical point, upon which fits a lever L controlled by an adjustable spring. The casting H is clamped on the brush pin by a set-screw, under the head of which is gripped a flexible copper connection leading to the cap of the brush. The lower end of the brush is guided by two rods R close to the surface of the commutator. The brush can be readily removed by simply lifting the lever, or it can be held off the commutator in case of need by resting on the front rod, against the hold-off pin shown.

The patentees claim that the holder combines all the advantages and merits of the many and various forms of the "box" and "lever" types of holders that have been evolved from time to time, but has not the shortcomings of either type, while it has

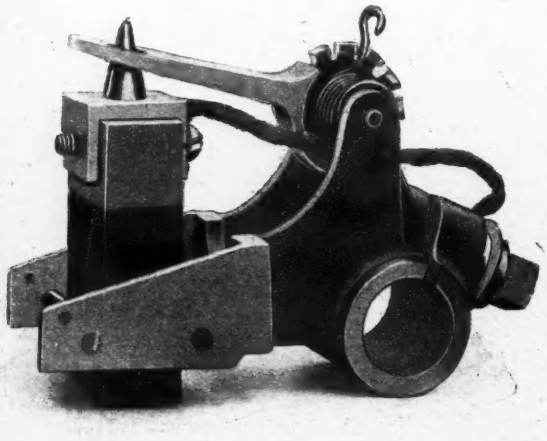


Fig. 1.—Cone-point Brush-holder.

special merits of its own which have not hitherto been combined in a single holder. The feed of the brush is all but parallel and frictionless, and the brush is as nearly a floating brush as it is practically possible to make it. The brush is supported and guided close up to the commutator surface, and it is next to impossible for it to rock in the "box" and so to cause the face of the brush in contact with the commutator to alter. The electrical contact between the brush and the holder, by reason of the brush being clamped in a metal cap to which a flexible connection is attached, is all that can be desired. The brush can be taken out of the holder, examined, replaced, or renewed as conveniently as with the usual type of box holder. The brush block is of simple rectangular shape, requiring no structural embedded connection, or special moulding, and can consequently be supplied and renewed at a minimum of cost and trouble.

Any size of holder casting can be readily adapted to take brushes of two or three different thicknesses, by placing the guide-bar studs at corresponding distances apart. The holder is provided

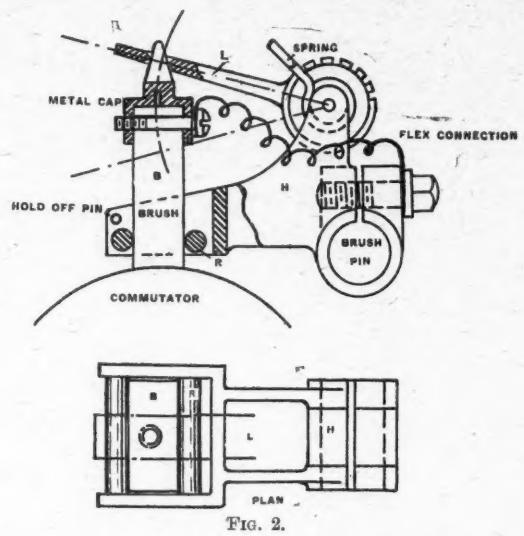


Fig. 2.

with a very simple and effective form of hold-off catch for the brush, which at times is very useful, and the tension spring is made adjustable.

Last, but not least, the brush is not liable to become set fast in the "box" by carbon dust, dirt, or by the use of various lubricating compounds.

The patentees consider that although possibly their holder may not prove to be suitable for very soft grades of carbon brushes such as some of the "Morganite" grades recently placed on the market, it is for all moderately hard grades of carbon, as generally used, a perfect holder, and they are hoping shortly to be able to make arrangements for placing the "cone-point" holder on the market, and for meeting the special individual requirements of motor and dynamo manufacturers.

Any of our readers who may be interested in this holder may communicate with the patentees through the Electrical Review, addressing "Cone-point."

Milan Exhibition Awards.—Messrs. Elliott Bros. have been awarded two Grand Prix for their exhibits.

Messrs. A. P. Lundberg and Sons' exhibit at this Exhibition has been awarded a Gold Medal.

Messrs. Reavell & Co., Ltd., of Ipswich, have been awarded the Diploma of Honour for the air compressors which they have exhibited in the British Section at the Milan Exhibition.

Bankruptcy Proceedings.—Frank Johnson, cycle maker and electrical engineer, Longlane, Billesden, Leicestershire.—Receiving order made October 18th, at Leicester Court, on debtor's own petition. The first meeting is to be held on October 31st, and the public examination on November 23rd.

C. L. Ford.—Under the failure of Chas. Leonard Ford, electrician, Hyde Road, Woodley, Stockport, who recently committed suicide, the unsecured liabilities amounted to £600. Debtor attributed his failure to want of capital and keen competition.

Chemical Welding.—We have received from the "Society of the Welding Plates and Powder J. Lafitte," whose British agency is at 40 and 41, Redcliffe Street, Bristol, a sample of its material, which consists of a semi-metallic plate, with grooves enabling pieces to be broken off of any desired size. This is placed between the red-hot parts which are to be welded, and, it is stated, greatly facilitates the process and improves the joint. The parts may be both iron or steel, or one iron and the other steel. A brazing powder is also made, and where the welding plate cannot be applied, a welding powder can be used.

Trade Announcements.—The Sloan Electrical Co., Ltd., are now agents in Lancashire for the Perfecta Seamless Steel Tube and Conduit Co., Ltd., and they keep a stock at their Manchester premises, 16, John Dalton Street.

The Helis Cell and Accumulator Co., Ltd., of 53 and 54, Chancery Lane, W.C., has been formed for the purpose of manufacturing and supplying the "Helis" dry cells, accumulators and other specialities.

Messrs. D. Santoni & Co., Ltd., announce that in future their title will be D. Santoni & Co. (1906), Ltd., and their address 15-17, Beauchamp Street, Brook Street, Holborn, E.C.

Correction.—In the paragraph headed "I.T.E. circuit breakers," which appeared on p. 625 of our last issue, an error occurred in line 11, where the word *overhead* should, of course, have been printed *overload*.

Liquidations. — London Outer Circle Railway Syndicate, Ltd.—This syndicate is winding up voluntarily, with Mr. W. R. Morrison, Salisbury House, London Wall, E.C., as liquidator. Creditors must send in particulars of their claims, debts, &c., by November 16th.

The Tram Seat Improvement Co., Ltd.—A meeting of this company is to be held at 18, Booth Street, Manchester, on November 19th, to hear an account of the winding up from the liquidator, Mr. Henry Baker.

For Sale.—The West Ham Education Committee is offering for sale certain electric generating plant (gas engine, dynamo, battery, switchgear, &c.) now out of use owing to a supply being taken from the public mains. See our "Official Notices" to-day.

Catalogues and Lists.—The Cyclone Grinding Wheel Co., 2 and 3, Tower Royal, E.C.—Four-page circular describing their B.B. grinding wheels, and giving instructions for users thereof. Tabulated price particulars appear of pure corundum, and emery and corundum wheels.

The General Electric Co., Ltd., London, E.C.—In view of the progress that is taking place in electric cooking and heating apparatus, the General Electric Co. has issued for the use of electric supply companies and corporations throughout the kingdom a series of illustrated pamphlets and cards setting forth information relating to their electric radiators, kettles, domestic appliances, also loose leaflets with an appropriate picture showing the application of electricity to printing, laundry service, bread-making, sawmill work, and household ironing. It is intended that the company shall supply numbers of these circulars for the supply authorities to circulate with their own name printed upon them instead of that of the G.E.C. The company has issued a new Section "S" 1906 sale list, setting forth briefly a variety of electric lighting accessories that are to be cleared from stock at reduced prices. The company is also issuing notification of advance in the prices of cables and wires, owing to the continued rise in cost of raw materials.

The Howard Asphalt Trough Co., Ltd., Trafford Park.—The company are sending out to their customers and friends a good stout card (6 in. × 9 in.) on which they give approximate rules for finding cable sections in very simple form and without Greek signs.

Messrs. Clarke, Chapman & Co., Ltd., Victoria Works, Gateshead-on-Tyne.—Copy of their latest catalogue giving in some 34 pages (approximate 5½ in. × 8½ in.) particulars of the Woodeson patent water-tube boilers. Some photographic views of the company's boiler shops, showing the boilers in course of construction, are followed by half-tone illustrations of the boilers in sections and complete, also fitted with superheaters, chain-grate stokers, and economisers. Some tabulated figures appear in the catalogue of factors of evaporation, properties of saturated steam, and other useful information. We understand that the boilers have given great satisfaction, and repeat orders have been booked.

Messrs. Mather & Platt, Ltd., Manchester.—Copy of the eighth edition (blue cover) of their catalogue of steel-clad electric motors. A brief description is followed by tabulated information concerning speeds, capacities, and code-words for motors of from 110 to 500 volts. Dimensions and weights are also fully stated. A description of the firm's starting and regulating switches is included.

Messrs. O. C. Hawkes, Ltd., 69 & 70, Aldersgate Street, E.C.—New catalogue (No. 22) showing the latest designs in XL patent induced draught electric stoves. The list contains 45 designs, the majority of which are quite new and are so arranged as to present a new series and style as each page is turned over; from classic designs in Sheraton, Chippendale and Adam styles the reader passes to some very correct French models and a good variety classed as modern art. But the cheaper types of stoves are also well represented at the end of the list, a range being shown from £2 10s. to £6 each. The firm's system lends itself to great variety in the style of construction. From the plain box form with which we are so familiar to the bold curves in antique iron, recalling Elizabethan models, the range is very wide. At the opening pages of the catalogue the system is explained in detail, and diagrams showing results obtained are appended, together with tests, including one made by Col. Crompton. We illustrated a typical example of the "XL" Hawkes radiators in our last issue (page 622).

The Electrical Co., Ltd., Charing Cross Road, London, W.C.—Catalogue (12 pp. 8 in. × 10½ in.) containing a brief account of the A.E.G. steam turbines. A number of photographic illustrations, which are printed on enamelled paper, show turbo-generator plants of this type that have been supplied for Continental service, and also a general view of the erecting shops at the A.E.G. turbine works. A diagram of the steam consumption of a 1,000-kw. set is given.

Messrs. G. Irving & Co., Ltd., 12, Canal Street, Nottingham.—Illustrated leaflet showing four designs of the "Ideal" electric light fittings which have been introduced for use in factories, mills, workshops, &c., where a movable light is required. The fittings are capable of extension to nearly twice their length, and are provided with a universal friction head which enables them to support themselves in any position. A swivel fitted at the bottom allows the light to be placed at any angle. The examples illustrated in the list represent wooden and metal pendants and single and extension brackets. Prices are stated.

Messrs. Bruce Peebles & Co., Ltd., London and Edinburgh.—We have received an advance copy of the firm's new pamphlet, No. 19, which is now being issued. It describes in detail the chief characteristics and the construction of the P.P.P. turbo-alternators. The photographs include one of five 1,550-k.v.a. 6,600-volt turbo-alternator sets for the Durham Collieries Electric Power Co., and two 1,250-k.v.a. sets supplied for Poplar electricity works. The pamphlet is a well-printed one of 16 pp., and is intended to be filed with other publications already issued.

Messrs. Samuel Gratrix, Jun., & Brother, Ltd., Quay Street, Manchester.—Illustrated catalogue (No. 153) wherein in the course of some 142 pages there are shown a great variety of electric light fittings, including electroliers, brackets, hall lamps, figures, standards, piano standards, desk pillars, combination portable bracket stands, candle-lamp standards for table lighting, pendant fittings, and so on. Prices are mentioned, and there is a numerical index.

Messrs. John Dugdill & Co., Failsworth, near Manchester.—Catalogue illustrating the firm's movable and extensible fittings, for which it is claimed that by their use the necessity for duplicating fittings may often be avoided, thus saving space and cost of wiring and fixing, and preventing unnecessary use of current. The fittings illustrated and priced in this publication include single and three-light extensible switch pendants with automatic double-pole switch and spring reel cord absorber; universal ceiling fittings suitable for draughtsmen's desks, laboratories, &c.; twin pendant for dressing-table use; focusing pendants with universal movements; telescopic tube pendant with ball stem and knuckle joint lamp attachment; also various wall and other bracket fittings designed on the extensible principle.

In the *Brush Budget* for October there appears a photograph of an additional workshop that has just been erected at Loughborough for making steel rolling stock; also a dozen small views under the title, "Sudden Tramways—A Struggle against Time," illustrating some quick construction work carried out by the Brush Co. in laying the new tramway route between Croydon and Sutton for the South Metropolitan Co. Other interesting features also appear, including some views in Moscow, where the company has a branch office.

Messrs. Donovan & Co., Birmingham.—Pamphlet No. 24, giving prices of their Birmingham standard incandescent lamps with non-hygroscopic vitrite caps; No. 25, particularising and pricing the "B.E.F." supply companies' fuse.

Mr. P. F. Brittain, 110, Cannon Street, E.C.—Illustrated (four-page) circular, showing some of the Diamond Foundry electrical castings.

Japan.—The *Financial News* says :—"There is a great demand for copper wire and cables in Japan."

Canada.—Montreal.—The Allis-Chalmers-Bullock, Ltd., have decided to largely increase their plant. The company will now go thoroughly into the development of two more important lines—viz., hydro-electric machinery and the Christensen air brake.

The Philip Carey Manufacturing Co., of Lockland, Cincinnati, are about to erect a million dollar plant on the outskirts of Montreal for the manufacture of all kinds of asbestos goods. The object of this move is to save the 25 per cent. duty on raw asbestos, which is found in America only.

Germany.—The Isolierwerk Gesellschaft is the name of a new company which has just been formed at Witten to manufacture a new insulating material.

LIGHTING and POWER NOTES.

Barking.—A very successful electrical exhibition was opened on Thursday, the 18th inst., at the Corporation Baths, by the chairman of the Electricity and Tramways Committee, Councillor Crow, and it remained opened until Saturday. The attendance exceeded all expectations; over 20,000 visitors passed in during the three days. The exhibits were numerous, and of an interesting nature, and among others, the following firms were represented :—Messrs. Crompton & Co., geared motors, &c.; Electromotors, electric hoist, &c.; Union Electric Co., crane controllers and Excello flame arcs; Krupka & Jacoby, tantalum lamps and adapters; General Electric Co., heating apparatus and fittings; Edison & Swan Co., fittings and lamps; British Prometheus Co., G. Braulik, Sunbeam Lamp Co., heating apparatus; Electrical Co., Nernst lamps; Temperley Transporter Co., and Rumney & Rumney. Several local contractors were well represented, and exhibitors, we learn, were well pleased with the amount of business done. We hope it will be reflected by an increased output from the generating station. Mr. H. L. Howard, the Council's electrical engineer, had charge of the arrangements, and is to be congratulated upon the success of the first exhibition of its kind held by the U.D.C.

Bath.—The prov. order of the R.D.C. has been extended for another year. If nothing is then done to carry out the order it will be cancelled.

Billinge.—By 5 votes to 3 the U.D.C. has decided not to apply to the B. of T. for an E.L. prov. order.

Canada.—Ontario.—So far applications to the Hydro-Electric Commission total about 68,000 h.p., as against an estimate of between 60,000 and 65,000 h.p.

Welland (Ontario).—The Welland Electric Light Co. has sold its business and plant to the recently-organised Welland Electrical Co.

Toronto.—Our Toronto correspondent, writing on October 9th, states that after a prolonged interview with the chairman of the Ontario Hydro-Electric Power Commission, the Premier of Ontario left for Ottawa to attend a conference of the Provincial Premiers and the Dominion Government. It is understood that Canadian power policy, as a whole, will have an important place in the deliberations.

Fort William.—On 3rd inst., during the visit of the Canadian Manufacturers' Association to Fort William, the inauguration of an electricity supply to the town took place. Electrical energy is generated at the Kakabeka Falls by the Kaministiquia Power Co. and transmitted 16 miles to Fort William. The company is ready to furnish 14,000 h.p. to the city, and sufficient energy is available to furnish 35,000 h.p. We understand that the price is to be about $28 per h.p. per annum.

The Canadian Westinghouse Co. is supplying two 1,100-h.p. Westinghouse-Parsons steam turbines and two McDougal two-stage turbine-type pumps to the municipality, for use in its fire department. The pumps have a capacity of 5,000,000 gallons of water every 24 hours.

Continental Notes.—France.—The question of the future of electricity supply in Paris, which is becoming more and more urgent as time goes on, appears likely to be temporarily solved by an agreement between the two parties whose propositions are before the City Council. According to *l'Industrie Electrique*, it is proposed that the existing concessions be prolonged to 1912 or 1913, to enable a gradual transition from the present systems to the homogeneous and comprehensive scheme which will, doubtless, ultimately be adopted. Curiously enough, the supply of gas is in a similarly tentative state, the gas company's existence being prolonged because the City Council cannot come to a decision in its case also.

It is reported that the E.L. companies (Secteurs) have arrived at an agreement with the Mildé - Schneider group of Creusot, for the purpose of submitting to the municipal council a joint scheme in regard to the future supply of electrical energy in the French capital, the adoption of which is regarded as probable. The existing companies are to participate to the extent of 60 per cent., and the other group to the amount of 40 per cent. in a new company which is to be constituted for undertaking the electric lighting business as from the year 1913 to the year 1934, and the existing companies are to continue in operation until the completion of the new works in 1913. It is proposed to lower the price of energy to 7 centimes per hectowatt-hour as from the inauguration of the scheme, by agreement with the municipal council, and to further reduce it to 6 centimes in 1913. It is assumed that the reduction in price will bring about a considerable increase in the consumption, which the present companies are unable to deal with, as they already obtain a portion of their supply from other quarters.

Germany.—The Berlin Electricity Works Co., whose generating stations have reached the maximum limit of their capacity, as was mentioned in this journal on October 19th, proposes to expend no less than £2,000,000 on extensions, provided that the municipal council will agree to the execution of the work under the terms of a suggested new agreement, beyond that which will expire in 1919. With a view to facilitating negotiations on the subject, the company has prepared a memorandum reviewing the extent of the system of supply. During the past year the company and the A.E.G. delivered more than 100,000 kw. for lighting and power purposes, excluding the supply to the tramways, and the increase which took place is largely attributed to the introduction of new electric lamps. In the case of the electric tramways, the delivery of electrical energy is said to have represented 50,000,000 kw. in the past year, of which 47,000,000 were for the Grand Berlin Tramway Co. alone. It is estimated that the total consumption in the current financial year will reach 113,000,000 kw., as compared with 97,000,000 in 1905-6. The share capital of the company is £1,575,000, and the bond capital £1,725,000. During the past year the payments made to the City Council under the company's concession amounted to £166,969, whereas the shareholders only received £130,000. The former sum is higher than that paid as imposts by the Grand Tramway Co., which handed over the amount of £117,296 as the city's share in the profits and the fixed sum payable under the concession.

The Rhein Valley Canal was constructed with the object of preventing floods when the Bodensee was too full of water; but the three levels by which it descends to the Rhine also creates 3-metre falls of water, whose value for electric generation has been readily recognised. Three generating stations have been built at Montlingen, Blatten and Lienz respectively, the first being the principal. Its equipment consists of three three-phase generators of 250 h.p. each; the two other stations—Blatten at 4 km. and Lienz at 5 km. distance—containing two 250-h.p. generators each. All three stations generate three-phase current at 10,000 volts, and work on a common system of a total length of 56 km. With a view to regulating the pressure in a simple way and facilitating the parallel working of the three stations, both the Lienz and the Blatten have been fitted with a synchronous generator. These run at a speed above synchronism, with short-circuited rotors. Such generators require regulation neither of the pressure nor of the speed, and need not be synchronised when paralleled on the network. The strength of the current of the generators with a given pressure and frequency on the network is invariable with a given performance of the turbine. When the load of the network is smaller than the performance of the turbines of the asynchronous generators, an acceleration of the synchronous generators of the chief central station occurs, which may be relieved by simply disconnecting the asynchronous generators or by shutting off their turbines. Regulation of the pressure of the network excitation and speed of the turbines is carried out at the chief station only, a single attendant being required for the service of each of the sub-stations. There is no exciter, and the switchboard contains only the main switches and ammeter. By these simplifications of machines and apparatus initiated by the Oerlikon Co., the service was expected to be appreciably facilitated, while the margin of safe working would be greatly increased, and this has been found to result in practice, the installation having worked perfectly smoothly since its starting in January last.

Austria-Hungary.—A sum of 13,602,000 kronen has been voted by the Bohemian National Committee for the construction of two dams on the upper Elbe, at Krausebaden and Königreihwald respectively, for electric generation purposes, and for the regulation of the courses of that river and of the lesser Elbe.

A project for the erection of a long-distance high tension electric transmission to serve 13 towns and localities in the neighbourhood of Gmunden has been evolved by the Elektricitätswerke Stern und Hafferl Aktien-Gesellschaft, who have applied for the concession. The current is to be transmitted at a pressure of 10,000 volts, and transformed down at four transforming stations conveniently situated to serve the various localities.

Turkey.—Electricity is making progress even in the Ottoman Empire, as is evident by the various schemes recently launched. A concession, for instance, for an electric lighting and tramway service in Broussa was recently granted to Mehemed Ali Bey; a Franco-Belgian syndicate has secured a concession for lighting and traction at Philippopol, and a concession for similar dual services in Beirout has been granted to Selim Trad Effendi.

Italy.—Under the title of "Urtis, Turin," a company has been established at Turin with a capital of 450,000 lire, to purchase and install electrical machinery and appliances. The president is Engineer Civita.

The Public Works Council has made an examination of the project submitted by the Technical Department of the Municipality of Naples, for the utilisation of the Volturno torrent at Rocketta to provide motive power for the city. The matter received favourable consideration, but will be subject to some observations in regard to tenure.

Important works have been authorised by the Minister of Public Works on the Folla torrent, in the Province of Udine.

The Japanese Ambassador at Rome, who has recently been visiting the important hydro-electrical works of Paderno and Vizzola, has expressed the opinion that Italy must now be regarded as the first nation in regard to large electrical power transmission schemes.

A contract has been entered into between the Co-operative Society of Electricity of Messina, and Messrs. Bonomo & Utili, of Naples, who have obtained an electric light and power concession at Messina. The generating plant is to consist of three steam sets of a total capacity of 1,500 h.p. Three-phase current will be generated at a pressure of 5,000 volts.

The Municipality of Rome has applied for permission to erect a station for lighting the town, and for industrial purposes. The estimated total cost of a station of 4,000 h.p. is estimated at 3,500,000 lire.

Spain.—The Vitigudino (Salamanca) municipality has invited tenders for the electric lighting of the town.

Croydon.—A L.G.B. inquiry was held on October 16th relative to the application of the T.C. for a loan of £22,830 for electricity purposes, £18,000 being for extension of mains and £4,830 for additional plant. It transpired that the latter work had already been done, and the Inspector adjourned the inquiry *sine die* for information which he required to be supplied.

Dartford.—The U.D.C. has decided to supply energy for outside arc lighting at 3½d. per unit, including the cost of trimming and the supply of carbons.

Dawlish.—Messrs. Crompton & Co. have informed the U.D.C. that they propose to transfer the E.L. order held by them to the Electric Supply Corporation. It is not proposed to vary the arrangements made with the Council, so the latter has decided to offer no objection.

East Ham.—At the meeting of the Town Council on Tuesday, a letter was read from the Local Government Board stating that it was not prepared to sanction a loan in respect of wages paid to permanent employés of the Council in connection with the fixing of meters, &c.

Edinburgh.—The T.C. has remitted to a sub-Committee the scheme laid down by Sir Alexander Kennedy. In this scheme there would be added to the equipment at the McDonald Road station four low pressure steam turbines, to take the exhaust from the existing engines, with condensers, the maximum capacity of the four being 4,800 kw. Lochend Loch would be utilised for condensing purposes, and the whole cost, including turbines and dynamos with condensers and pumps, also pipe connection to Lochend, and allowance for the purchase of land would not exceed £67,000.

Hoylake and West Kirby.—The U.D.C. has applied to the L.G.B. for a loan of £2,000 for mains and services.

Ilford.—A L.G.B. inquiry was held on October 16th into the application of the U.D.C. for a loan of £10,000 for E.L. purposes. There was no opposition.

Leeds.—Messrs. Butler's Trustees, Ltd., engineers, have recently decided to run their works at Stanningley, near Leeds, entirely by electricity from the mains of the Yorkshire Electric

Power Co. The works are at present equipped with a number of isolated engines, which have been added from time to time as found necessary, but for some time the company has had the change under serious consideration. We learn that a contract has been placed with Messrs. Wilson, Hartnell & Co, of Leeds, for motors aggregating 650 H.P., which are to be installed in the works.

Liverpool.—The city debt on December 31st, 1905, amounted to £15,210,000 Mr. Sidney S. Dawson, F.C.A., one of the city auditors, has just issued a detailed report on the finances of the city. The position of the E.L. and Tramways Departments is shown, as at December 31st, 1905, in this report:—

TRAMWAYS UNDERTAKING.

Income.—Traffic and other receipts	£557,055
Expenditure.—Working and general expenses	£381,378
Sinking fund	55,297
Interest	44,421
Renewals and depreciation fund	50,639
Contribution in aid of general rate for 1906 ..	25,320
	£557,055

ELECTRIC SUPPLY UNDERTAKING.

Income—Electrical energy and other receipts	£246,367
Expenditure.—Working and general expenses	£98,235
Sinking fund	42,478
Interest	54,879
Reserve fund	17,875
Renewals and depreciation fund	13,160
Contribution in aid of general rate for 1906 ..	19,740
	£246,367

The departments in question figure in the list of "Some of the Assets of the Liverpool Corporation as at December 31st, 1905," as "Tramway undertaking at cost, less repayment of debt and various reserve funds: £1,248,000. Electric supply undertaking at cost, less repayment of debt and various reserve funds: £1,443,000.

London.—HACKNEY.—The E.L. Committee has reported that the storage battery at the works was put into commission on October 31st, 1901. In order to make the best use of the energy provided by the destructor during the daytime the battery has been charged and discharged twice per day, so that the plates have lived the life of a battery used normally once per day for 10 years. Many of the plates are now in a bad condition, and the old positive plates must be completely renewed. The expenditure (£1,800) is to be met out of the reserve fund. In a further report the Committee says that, owing to the resolution of the Council adopting the flame type of arc lamp for extensions of street lighting, the estimate of the work is as follows:—Public lighting account, flame arc lamps, pillars and gear, £3,900; mains accounts, arc lighting and distributor cables, £5,600.

ST. PANCRAS.—The Electricity Committee of the B.C. has received a report from Mr. S. W. Baynes, the borough electrical engineer, submitting a scheme of thermal storage on the Druitt Halpin system, which would enable the new turbines to be driven from the old boilers, and thus avoid the expense of an additional boiler house, boilers, steam pipes, &c. From the following information he had collected, it would be seen that the evaporation had been increased to nearly three times the normal, but this was an excess he considered it would not be wise to count upon:—

Works.	Boiler.	Coal.	Rated capacity.	Capacity with thermal storage.	Time in use.
Hammersmith B.C. Electricity Works	3 dryback marine	Small Welsh	13,300 (with forced draught)	25,000	12 months
Hammersmith B.C. Electricity Works	1 B & W.	Small Welsh	10,000	27,000 (forced draught)	12 months
Willans and Robinson	1 Niclausse	Midland hard steam	6,000	15,000	—
Wood Lane, W.	5 B & W.	Small	12,000	27,000	2 years
St. James' and Pall Mall E.L. Co.	3 marine	—	10,000	18,000	—

In notes to the above, it is stated that a further order has been given for Wood Lane for two additional boilers to be fitted with similar storage. Continuing, Mr. Baynes says that he has obtained an estimate from Mr. Druitt Halpin, the inventor of the system, to install thermal apparatus capable of feeding the boilers with 20,000 lb. of water per hour for three hours, including delivery, erection and the necessary girders, but excluding the foundations, for £2,345. The cost of the foundations would be about £300, making a total cost of £2,645 for applying thermal storage to the four B. & W. boilers at the King's Road works. On the other hand, four new boilers, with the necessary new buildings, would cost £13,716. Therefore, by the adoption of the thermal storage there would be a saving in capital of £11,071. The Committee has endorsed the suggestions of the electrical engineer.

MARYLEBONE.—Reporting on Tuesday on Mr. Plowden's recent decision with regard to the summonses taken out against the Council by Messrs. Mappin & Webb, in respect of alleged defective supply of energy, the Electricity Committee stated that, as to the continuing penalty of £2 for each day in the future that the standard pressure was not kept up, the solicitors had satisfied the magistrate that he had no power to grant continuing penalties for the future, and he had accordingly directed that no effect should be given to that part of the conviction in the event of an attempt being made to enforce the same.

The revenue account relating to the undertaking for the quarter to June 30th last showed a credit balance on the quarter year, after providing for working expenses, of £19,829; 1,483,514 units were sold at an average price of 4·8d., including rental of meters, and brought in £29,647. The working expenses totalled £9,905; 20 per cent. of the charges for interest on loans, payments to sinking fund and suspense account would be applicable to the June quarter, and would amount to £15,154, and after deducting this, there would be available a credit balance for deferred sinking fund, depreciation, &c., of £4,675 for the three months. The cost per unit sold was 1·439d. as against the estimated cost of 1·626d., and the average cost in the case of the whole of the other municipal supply undertakings of 1·65d. The Committee hopes particularly to reduce costs with regard to management. The excessive cost is due almost entirely to the work arising out of the change of pressure.

L.C.C.—The Highways Committee at Tuesday's meeting of the Council reported that, as a result of the authority given last July, it had considered the question of electric supply, and had decided to recommend that legislation should be introduced in the session of 1907 to authorise the Council to supply electrical energy in London and certain surrounding districts. It would be necessary in taking that course to proceed under the provisions of the Borough Funds Act (1872), as applied by the County Councils (Bills in Parliament) Act (1903), and notice would, therefore, have to be given by public advertisement of intention to consider the question of promoting such legislation at a meeting to be held on a specified date. The Committee accordingly recommended that notice should be given of proposal to consider the subject at the meeting to take place on November 6th.

Mansfield.—The T.C. has signed an agreement with Mansfield Woodhouse U.D.C. for the supply of energy to the latter district.

Mexico.—A large electric power station has just been erected at Las Rosas, near Queretaro. Water power is being utilised.

Rossendale.—At both the Rawtenstall and Haslingden Town Council meetings this week, the proposal of a joint electricity scheme for Bacup, Rawtenstall and Haslingden was discussed. It was decided to obtain a report from an electrical expert as to the practicability of a joint scheme, giving details of cost of generating station, distributing mains, &c. An idea of the probable demand will be obtained.

Sheffield.—Messrs. Vickers, Sons & Maxim will shortly introduce into service at their River Don Works two turbines—one of 2,000 KW. by Messrs. C. A. Parsons & Co., and one of 1,000 KW. by Messrs. Willans & Robinson. These will be coupled to Vickers alternators, and run at 1,500 R.P.M. Three-phase current will be generated at 650 volts, and distributed to various centres in the works, where it will be converted into D.C. at 220 volts by 400-KW. motor-generators. Four of these motor-generator sets have been built for working in the various sub-stations, and more will, we understand, be added as occasion arises. The adoption of three-phase current is not in any way intended to supersede the existing direct-current 200-volt supply, but is an extension necessitated by additions to the workshops; some of the new buildings are situated at a considerable distance from the power house. Several novel features are being embodied in the turbines, as the Willans turbine is being bladed on the Ferranti system by electric welding, and the Parsons turbine will be of the re-superheated type, as developed by Mr. Ferranti in conjunction with Messrs. Vickers, Sons & Maxim, Ltd.

Southampton.—The Electricity Committee has recommended the T.C. to reduce the price of energy for power to 2d. per unit.

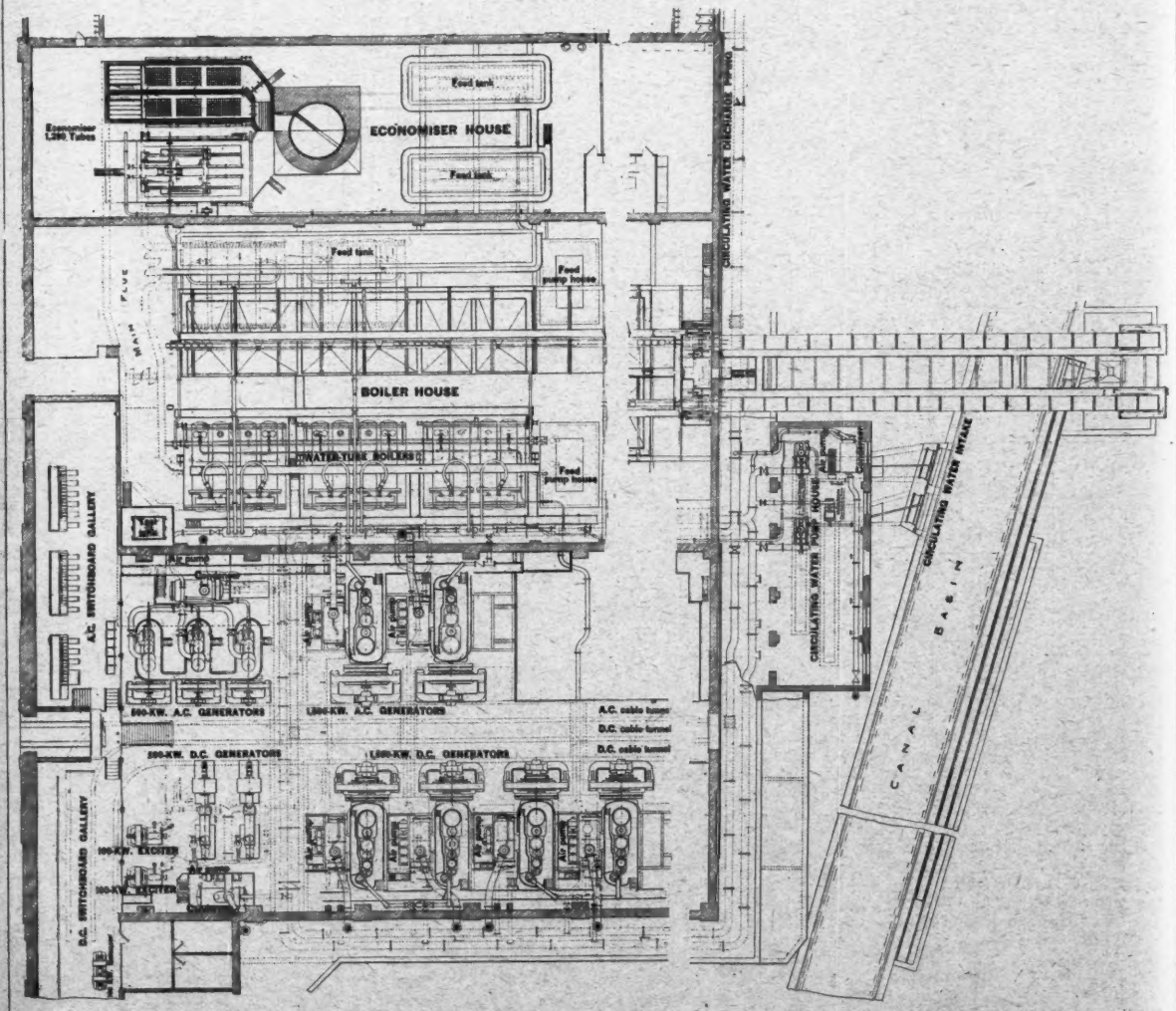
Stoke-on-Trent.—A L.G.B. inquiry was held on 23rd inst. into an application by the T.C. for sanction to borrow £1,998 for the provision of further plant at the electricity works. There was no opposition.

Sunderland.—An electrical exhibition, to remain open for a week, was opened at the Town Hall on Monday last. The Corporation and the Sunderland Electrical Contractors' Association are the promoters of the exhibition.

Worthing.—The Electricity Committee of the T.C. has recommended that electricity be supplied for heating purposes at 1½d. per unit from April 1st to September 30th, and at 1½d. from October 1st to March 31st except between 5 p.m. and 8 p.m., when the charge will be 2d. per unit. The appointment of a competent canvasser for two months is also recommended.

Birmingham Tramways.—On Saturday last several persons were seriously injured by the overturning of a tramcar belonging to the corporation. Turning from Frederick Street into Warstone Lane the car left the metals and fell over. Three passengers riding on the top were thrown to the road, and seven passengers were so badly injured as to necessitate treatment at the hospital. From a local source we gather that the car was travelling at much too high a speed at the point where it left the track.

Electricity Supply in Birmingham.—Fig. 1.—Cross-Sectional Elevation of the Summer Lane Generating Station.



Electricity Supply in Birmingham.—Fig. 2.—Plan of the First Installation, Summer Lane Generating Station.

ELECTRICITY SUPPLY IN BIRMINGHAM: THE NEW SUMMER LANE STATION.

In our issue of October 12th we outlined briefly the history and recent development of electricity supply in the city of Birmingham, in connection with which the opening of the Summer Lane station marks a great step in advance.

This station, with its complement of transmission and transforming plant, has, as was mentioned in our earlier article, been laid out to give the following classes of supply :—

1. A direct-current supply for private lighting and power purposes in the neighbourhood of the station, at pressures of 220 and 440 volts.

2. A direct-current supply through a system of trunk mains to the distributing switchboards at Dale End and Water Street generating stations, at a pressure of 440 volts, in order to deal with the increase in demand for private lighting and power in those districts.

3. A direct-current supply to the electric tramways within a two-mile radius, at a pressure of 550 volts.

4. A three-phase alternating-current supply, at 5,000 volts pressure, to substations in the outlying districts.

The building, which has a handsome front elevation facing Summer Lane (fig. 3), is divided into three bays, viz., engine house, 275 ft. × 100 ft. wide in one span; boiler house, 275 ft. × 89 ft.; and economiser house, 275 ft. × 47 ft. wide.

A workshop, switch galleries, battery room and mess room, &c., are situated at the Summer Lane end of the building, and at the opposite end runs the Birmingham and Fazeley Canal, an arm of which provides coaling facilities and circulating water for the condensing plant; a detached pump house adjoining the canal basin, houses the centrifugal pumping plant in connection with the latter.

The elevation and plan, figs. 1 and 2, show the general arrangement of the station and plant.

The architects for the building were Messrs. Ewen Harper and Brother, and the contractors for its erection, Messrs. Wm. Sapcote & Sons, all of Birmingham. Sub-contractors to the latter firm were Messrs. E. C. and J. Keay, Ltd., who supplied the whole of the 2,500 tons of steel and iron work used in the construction of the building, including the coal bunkers.

Fig. 3.—The New Summer Lane Electricity Station, Birmingham.

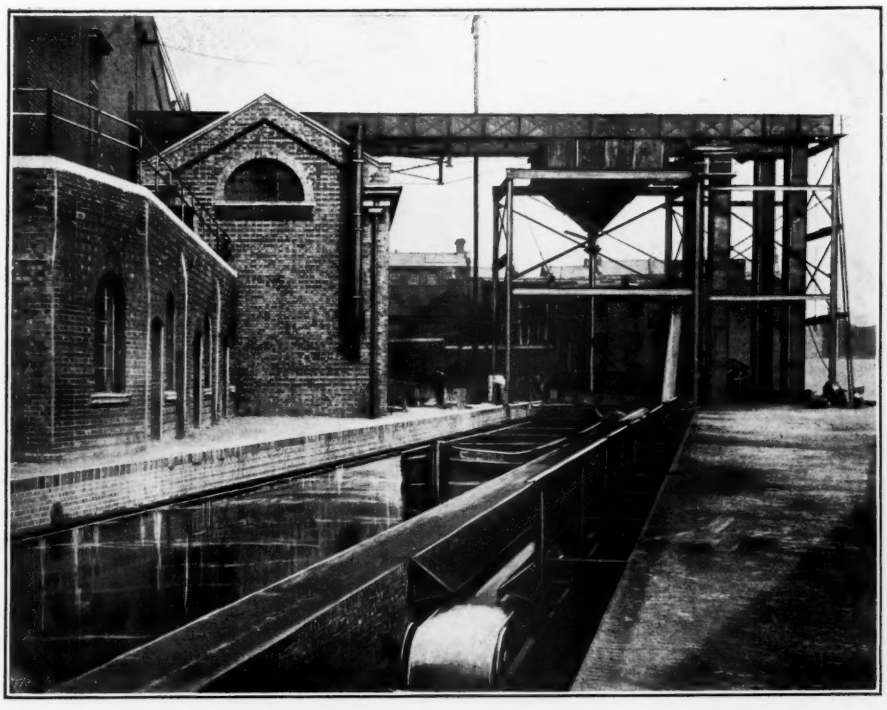


Fig. 4.—The Coal Handling Plant; Barge, with Belt Conveyor in the Foreground.

As the ultimate equipment of the station will include 26,500 kw. of generating plant, the coal-handling problem was obviously of very great importance, and a most complete installation for this purpose has been provided by the New Conveyor Co., Ltd.

The Canal Basin runs at right angles to the boiler house, and close to the edge of the basin a 24-in. band conveyor of the Robbins' type, is installed; this is capable of dealing with 60 tons of coal per hour, from three barges simultaneously, and is shown in fig. 4.

This conveyor feeds into a small hopper, from which the coal drops into an "Ingrey" weighing machine, where the weight is automatically recorded, and then into a hopper at the ground level; from the latter it falls into the filling apparatus of the gravity bucket conveyors. When coal is brought to the station by cart, it is tipped into this hopper at ground level and fed to the conveyors in the same way.

Two gravity bucket conveyors have been installed, each with a capacity of 60 tons per hour and 960 ft. long, and provision has been made for fixing a third similar conveyor, at a later date, for the purpose of feeding and drawing from an auxiliary coal store, which is to be erected on the wharf and which will be capable of accommodating 3,000 tons of coal.

The bucket conveyors are fed through patent automatic fillers.

Inside the boiler house, the conveyors rise vertically to the point where the driving gear is fixed, prior to passing over the coal bunkers, which accommodate 2,000 tons of coal.

They return through the basement, for ash-handling purposes, and over two 60-ton ash bunkers, one situated over the roadway for loading into carts, the other over the canal—arranged for loading into barges—and shown in fig. 4.

The motors driving the plant were made by the Electric Construction Co., Ltd., and consist of two 16-H.P. motors for the bucket conveyors and a 6-H.P. motor for the band conveyor.

In the boiler house ten Babcock & Wilcox boilers, each having 6,182 sq. ft. heating surface and constructed for a working pressure of 180 lb. per sq. in., are installed on either side, as shown in fig. 7.

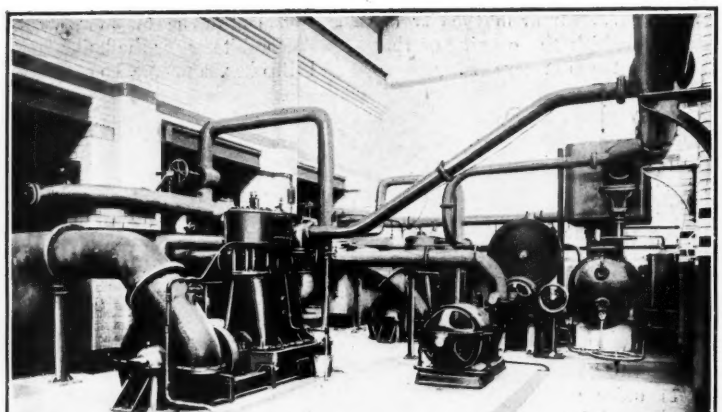


Fig. 5.—Centrifugal Circulating Pumps in the Pump House.

Each boiler is fitted with a superheater, capable of imparting 150° F. of superheat, and a double mechanical chain grate stoker, giving a total grate area of 100 sq. ft. The stokers are fed through spouts from the bunkers, and are driven by means of an eccentric from shafts fixed in the ash tunnel. A shaft may be driven by a steam engine or motor, either being capable of driving the stokers for 12 boilers.

Each boiler will evaporate 24,000 lb. water per hour with $\frac{3}{4}$ in. natural draught, and assuming coal of at least 10,000 B.TH.U's.

The underground flues from the boilers lead through a Green economiser of 1,280 tubes, to the chimney base in the economiser house. The usual bye-pass flue has been provided. One chimney, 15 ft. internal dia., and 230 ft. high, lined with firebrick for a distance of 50 ft., has been erected; the foundations of the second are in position.

Large water storage tanks have been erected in the economiser house, for storing cold water from the town mains and hot water from the air-pump hot-well discharge. These supply the boiler feed pumps.

The latter are installed in two pump houses, constructed midway in the banks of boilers on either side of the building. They were supplied by Messrs. G. and J. Weir, and consist of four vertical single direct-acting

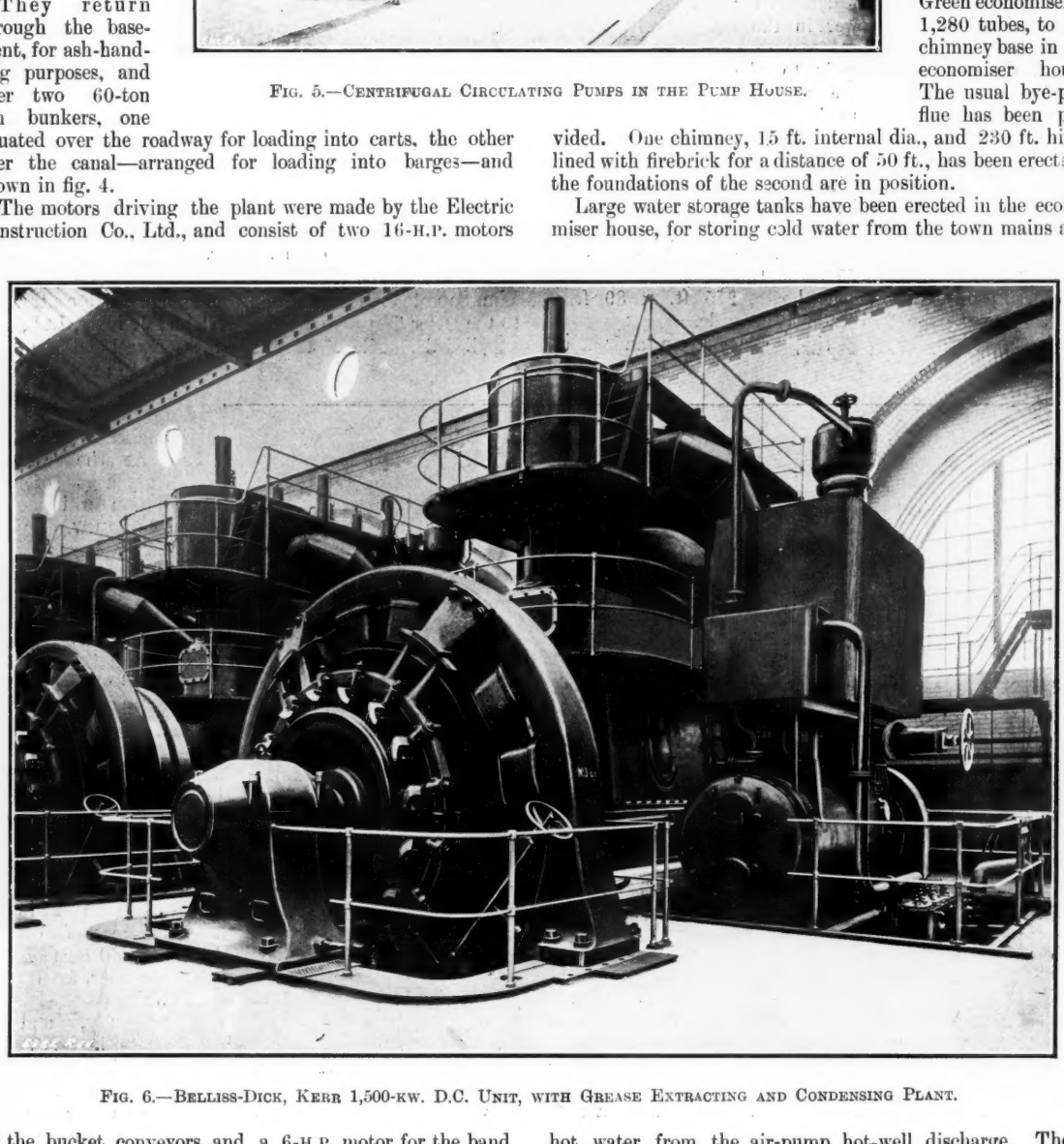


Fig. 6.—Belliss-Dick, Kerr 1,500-kw. D.C. Unit, with Grease Extracting and Condensing Plant.

pumps, each capable of delivering 8,000 gals. of water per hour.

The make-up water from the city mains is passed through a Berryman feed water heater, heated by the exhaust steam from the feed pumps.

A large testing tank, capable of containing 8 tons of water, is provided for testing the boilers by weighing water into them, and for testing engines by weighing the hotwell discharge from the air pumps.

The whole of the high pressure steam, feed and drain pipes, also the low pressure, exhaust, suction, discharge, blow-down and fire service pipes were supplied and erected complete by Messrs. Stewarts & Lloyds, Ltd.

The former consist of wrought steel lap-welded pipes; the large pipes have solid welded flanges and the smaller ones, stamped steel flanges screwed and expanded on.

An interesting feature of this installation is that all branches are electrically welded on, by Stewarts and Lloyds' well-known process.

The main steam range, which runs at the back of the boilers, next to the wall dividing the boiler and engine rooms, consists of a series of large headers and expansion bends. The headers, each of which is served by four boilers, were manufactured from ½-in. thick lap-welded tube by the electrical process; and all outlets, inlets and flanges are electrically welded on: the bottom outlets, with the exception of the central one, which acts as a drain, project a distance of 12 in. inside the headers, so as to prevent condensed water from finding an egress thereby. These headers are quite unique, and are a very fine example of what can be done by the electric welding process. The 10-in. expansion bends, connecting to the headers, are the usual "Horseshoe" type.

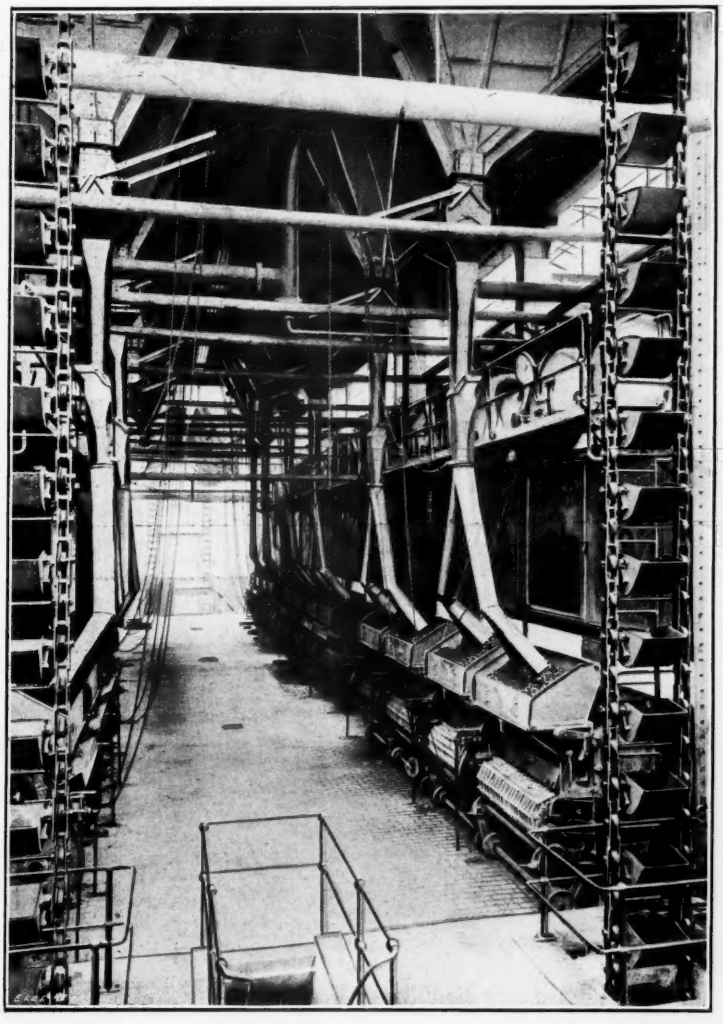


Photo. by] [*Thomas Lewis, Birmingham.*

Fig. 7.—The Boiler House.

Another interesting feature in the boiler room is a 10-in. double-bend expansion piece placed in a vertical position, which contains 25 ft. of ⅜-in. thick wrought steel lap-welded tube, bent in one piece, with welded outlets.

In the engine room also there are three large separators, viz., one on each of the 12-in. mains to Belliss engines, and the other on the 8-in. main to the turbos and small exciters.

The high-pressure feed mains are of wrought steel lap-welded tube; all branches are electrically welded on.

In the engine room, fig. 9, the first instalment of generating plant, much of which is in position, includes four 3,000-I.H.P. engines, operating 1,500/1,875 KW. direct current generators by Messrs. Dick, Kerr & Co.; two similar sized engines, operating alternating current generators of the same capacity by the British Westinghouse Co.; and three 1,000-I.H.P. engines, operating 500/625 KW. British Westinghouse alternators.

For exciting purposes two 180-I.H.P. engines coupled to generators by the General Electric Co. are installed.

All the above engines were supplied by Messrs. Belliss and Morcom, and are of their well known high-speed enclosed triple-expansion self-lubricating type, designed for operating with superheated steam.

Two 500-KW. D.C. turbo-generators of Messrs. Parsons' well-known type, which we illustrate in fig. 8, are also installed. These turbines, together with the two exciter engines, exhaust into a surface condenser, with motor-driven air pumps, supplied by Messrs. W. H. Allen, Son & Co.

The engines for the direct current and alternating current sets are strictly in duplicate, the only variation being a slightly higher rate of revolution in the A.C. sets to correspond to 25 alternations per second. The D.C. sets run at 160 R.P.M., and the A.C. sets at 166⅔ R.P.M.

The governors are designed to keep the speed within 2 per cent. of the normal over a load range from nil to 25 per cent. overload, *i.e.*, 0 to 1,875 KW. The power is carried at the higher loads by automatically varying the cut-off, and at the lower loads by throttling.

All the bearings are supplied with oil under a pressure of 20 to 30 lb. per sq. in., an arrangement which has been extended to the tail bearings of the electric generators.

The engines are also fitted with emergency steam stop-valves, so that steam can be quickly shut off should occasion arise.

Each main engine is provided with its own surface condensing plant arranged alongside the engine, and designed to maintain a vacuum within 3 in. of the barometer, with the engine on full load, the vacuum being specified not to fall below 25 in. at the maximum load of the engine with cooling water at a maximum initial temperature of 85° F.

The exhaust steam before entering the condenser passes through a "Baker" grease extractor, a sluice valve being fitted between the latter and the condenser, so that the condenser may be laid off for cleaning whilst the engine exhausts to atmosphere through an automatic valve, which has been provided for emergencies. Each condenser has a total cooling surface of 4,200 sq. ft.

The air pumps are of the Edwards three-throw type, running at a normal speed of 80 R.P.M., but arranged for

speeding up to 120 R.P.M., so as to enable each set of air pumps on emergency to serve two main condensers. An inter-connecting air-pump suction main is provided for linking up any air pump to each condenser; and the air pumps are alternately steam and motor driven. Two hot-well pumps are driven from each set of air pumps, discharging into the hot-well storage tanks situated above the boilers.

Our illustration, fig. 6, on p. 672 shows a 1,500-KW. unit complete with condensing plant.

The large condensing plants are by Messrs. Belliss and Morcom, who were also responsible for the complete system of oil cooling, storage and treating tanks for dealing with the crank-chamber oil.

In connection with this oil system there are two sets of auxiliary motor-driven oil pumps, which are also available for delivering oil under pressure into the oil-pipe system of any engine. The oil extractor pumps for the "Baker" separators are worked by the same motors, and large vacuum tanks are also installed for use when the pumps are not in operation.

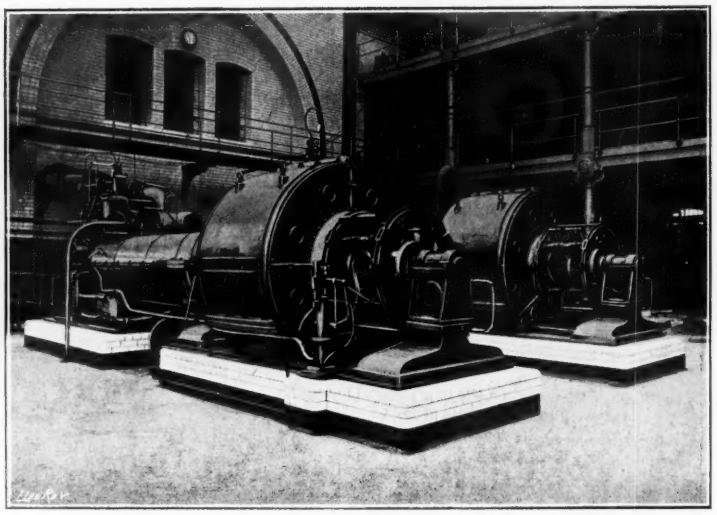


FIG. 8.—500-KW. PARSONS D.C. TURBO-GENERATOR UNITS.

driven Edwards air-pump is installed, and provision is made for installing three further 20-in. steam-driven pumps as required.

The pumps draw water from two distinct underground culverts, which are connected to the private basin of the canal by channels in which straining apparatus is fitted; they deliver their water into a system of 24-in. riveted steel pipes which run completely round the engine house, with connections to each condenser.

The return water is carried away through a similar system of piping, which is joined up to a 30-in. dia. cast-iron pipe laid underground to a point a third of a mile distant from the generating station, where the water is returned to the canal over a weir.

The three 500-KW. engines are similar in design to the larger units; they run at a speed of 250 R.P.M., and exhaust into a common surface condenser, which is a duplicate of the plants supplied for the larger engines. The exciter engines are of the two-crank compound type.

In the case of the four 1,500-KW. D.C. generators, which

FIG. 9.—GENERAL VIEW OF THE ENGINE ROOM, SHOWING THE A.C. PLANT ON THE RIGHT, SWITCH GALLERIES AND CRANE.

In Fig. 5, p. 672, shows the circulating water pump house, which is equipped with two 20-in. steam-driven centrifugal pumps and one 12-in. motor-driven centrifugal pump, supplied by Messrs. W. H. Allen, Son & Co., Ltd.

The steam pump sets exhaust through a grease separator into a surface condenser, in connection with which a motor-

are 16-pole compound-wound machines, and have an overload capacity of 25 per cent., the spider of the armature is extended and bolted direct to the fly-wheel of the engine.

It is intended to use these machines either for lighting or traction supply.

The D.C. turbo-generators are shunt wound for a pressure

of 460 to 520 volts, each having an overload capacity of 10 per cent.

The alternating current generators are standard Westinghouse revolving field units, designed to generate three-phase, at 5,000 volts and 25 periods.

In their case the revolving fields are bolted direct to the engine fly-wheels; each set has an overload capacity of 25 per cent.

The exciters have an output of 100 KW. at from 440 to 480 volts, and an overload capacity of 10 per cent. for one hour.

Among the smaller miscellaneous plant are two Phœnix motor-driven balancers, each of 100-KW. capacity, installed for dealing with the out-of-balance current on the local lighting network; and two Phœnix 25-KW. motor-driven three-wire boosters to give the necessary increase in pressure on the trunk main supply to the Dale End and Water Street generating stations.

The latter machines, which are each capable of dealing with a current of 2,500 amperes and will boost up to 10 volts either positively or negatively, consist of a motor and two boosters for dealing separately with each side of the three-wire network.

It is proposed to install two additional similar sets in the future, and four sets of 20-KW. three-wire motor-driven boosters, each capable of dealing with 1,000 amperes and boosting up to 20 volts on each side of the local three-wire lighting network supplied from this station.

A further 200-KW. motor-generator, by the Phœnix Co., is installed for giving a direct current supply to the tramway system off the lighting bus-bars during the light load at night time; it is also proposed to install a 200-KW. rotary converter and bank of transformers, to enable the extra high-tension alternating current supply to be coupled to the low tension direct current supply, in order to avoid running steam plant on both classes of supply at times of light load, and a large storage battery with a reversible booster, for equalising the load upon the direct current generators used for supplying the electric tramways.

The engine room is spanned by a large overhead electrically driven four-motor crane, built by Messrs. Jessop and Appleby Bros. (Leicester).

This is capable of lifting a weight of 40 tons on one lift and of 10 tons on a second lift, its span being 97 ft. 6 in.

Each crane is equipped with four 440-volt Westinghouse motors, those for operating the heavy and light lifts and longitudinal traverse being of 12 B.H.P., and that for the cross traverse being of 7 B.H.P.

Controllers of the liquid type, with screw reversing mechanism and powerful automatic magnetic and other brakes, are included in the equipment.

An additional means of control to prevent any possibility of over-running, is a time-limit switch with catch, which is set in operation by the lift ropes at the desired point, one switch being used both for the main and auxiliary hoists.

The speeds of the various motions are as follows:—Main lift with 40-ton load, 18 in. per minute; auxiliary lift with 8-ton load, 12 ft. per minute; cross traverse, 80 ft. per minute; and longitudinal travel, 80 ft. per minute.

(To be continued.)

TRAMWAY and RAILWAY NOTES.

Brighton.—An electrical exhibition, which is to be held under the auspices of the T.C., will be opened on January 5th next in the Aquarium. The exhibition will remain open until January 26th, and firms desirous of exhibiting will find further particulars in our advertisement pages to-day. It may be of interest to record that at the last exhibition of the kind held by the T.C. four years ago, over 70,000 visitors paid for admission.

Canada.—WINDSOR (ONT.).—Work on the Windsor and Tecumseh Electric Railway, the franchise and rights of way of which recently passed into the hands of the Detroit United Railway, will shortly be commenced and pushed forward as quickly as possible by the new owners.

Continental Notes.—SPAIN.—The Tranvia de San Fernando á Cadiz at a recent meeting increased its capital by 1 million pesetas, with a view to extending its line to Chiclana.

Sanction has been given to the Bilbao Tramway Co. to substitute electric for animal traction on the tramways in that city, and to widen the gauge of its tracks.—*Board of Trade Journal.*

ITALY.—H.M. Consul at Milan reports that the Enterprise Générale des Travaux, of Liége, has received a concession from the Italian Government to construct and work a tramway line which will connect Desenzano with Castiglione delle Stivere, and another line which will unite Carpenedolo and Montechiari.—*Board of Trade Journal.*

An offer has been made to the Palermo municipality to construct a tramway 28 km. in length, to Valdese. The project is promoted by Sig. Ugo Cassalis, of Milan.

RUSSIA.—The Société des Tramways de Kiew is putting down a new 400-H.P. Diesel engine at its generating station in Kiew.

BAVARIA.—Various schemes have of late been put forward to obtain water power from the highlands, which would provide, on an official estimate, 300,000 H.P., not only to the State railways throughout Upper Bavaria, but also to private industrial enterprises. Recently the Minister of Communications of the Bavarian Government expressed the hope that the electrification of the Bavarian State railways was only a question of time. The construction, however, of electric railways in the highlands would be left to private initiative.—*Board of Trade Journal.*

Durham.—An electric tramcar carrying mails through the colliery districts caught fire on Friday near Hetton, and was practically wrecked. The passengers aided the officers in salving the mail bags.

Folkestone.—It is reported that the T.C. is so satisfied with the Dolter system, that it has been decided to waive the clause in the agreement with the National Electric Construction Co., whereby the company were to wait six months before commencing the tramways, in order to see if the system works satisfactorily elsewhere.

Glasgow.—The general manager of the tramways has been authorised to fit on the cars an appliance for regulating automatically the height of the life guard trigger, and also to fit on a side life guard.

Halifax.—A mishap occurred on the tramway system last week which might have led to disastrous results. On the Pye-Nest section, between King Cross and Sowerby Bridge, at a point which is admittedly one of the worst on the Halifax system, when a car had ascended the gradient and rounded a curve, the power failed, and the car, owing to the sudden rebound, began to run back with increasing momentum, but, by wise use of the hand brake, was pulled up at a distance of 470 yards. Four passengers jumped off, and were more or less hurt. The driver reports that "the current left the controller," and further says a reason which helped the car to run back was the greasy state of the track. Immediately the car began to run back, the driver applied the electric brake and reversed his slipper brake, and the conductor applied the slipper brake at his end. The manager points out that the dirt on the rails contributed to the car running back, but it is quite possible that power might leave the controller without leaving the line.

Lancaster.—The half-yearly report of the Corporation electric tramways presented at the Council meeting last week, showed that 836,620 passengers had been carried, an increase of 7,929, and an increase in receipts of £250. The abolition of ½d. fares has, during the past month, produced a decrease of 14,671 passengers, but increased the receipts to £28.

London.—L.C.C.—The Council in July last authorised the Highways Committee to communicate with the Board of Trade and the several road authorities concerned with a view to the adoption of the overhead trolley system on the existing horse tramways from Cambridge Road, *viâ* Mile End Road and Bow Road, to the county boundary at Bow Bridge. We gather that the Poplar Council, in whose district a portion of the tramways is situated, concurred in the County Council's proposals, and the Committee had therefore considered the question of the arrangements to be made for the conversion and working of the lines in that borough, which extend from near Coborn Road eastwards to the county boundary. It was important that the lines should be in operation as soon as possible, especially as they form a connection at the county boundary with the West Ham tramways, and it would be of advantage for through car services to be run over the tramways of both authorities. The Committee proposed to report fully on the proposal at an early date with a view to definite arrangements being made with West Ham.

STEPNEY.—The L.C.C. has persisted in its desire to construct tramways along Mile End Road and Bow Road on the overhead system, but the local authority remains obdurate and reiterates its objection to that system.

FULHAM.—Much dissatisfaction has been expressed in the district in consequence of the delay by the L.C.C. in executing the proposed tramways along Fulham Palace Road from Putney Bridge to Hammersmith. The Works Committee of the B.C. has decided to urge the L.C.C. to proceed without further delay with the scheme.

CITY AND SOUTH LONDON RAILWAY.—It is announced by the directors that the new extension from Islington to Euston Station will be opened for traffic next March.

Maidstone.—The Corporation has decided to apply for an order sanctioning the construction of the light railway system along Mill Street and Knightrider Street to join the proposed light railway to Loose. Further, it has asked its consulting engineer (Mr. Sellon) for advice on the desirability of applying for powers to extend the tramway system to the neighbouring village of Tovil.

Manchester.—The Tramways Committee has approved the details of a new scheme in regard to its parcel-carrying system. The whole of the collecting and delivery vans at present in use are to be dispensed with, and parcels up to 14 lb. in weight will be carried on the tramcars and delivered to the consignees by messenger boys. Under the new arrangement parcels may be handed to guards in Manchester at any stopping place, who will take payment for carriage and give a receipt. On arrival at its destination the parcel will be delivered to the address given, providing it is within half a mile of the tram route. These parcels will be carried on the cars between the hours of nine o'clock and six o'clock each day, except Saturday, when parcels will not be accepted after 4 p.m. The charges have been fixed at 2d. for any parcel up to 7 lb. in weight, and 3d. for parcels exceeding 7 lb. in weight up to 14 lb.

Oxford.—The T.C. has sealed the contract with the National Electric Construction Co., Ltd., for the construction of tramways in the city on the Dolter system, after it has been satisfactorily worked in an English town for at least six months.

South Africa.—Johannesburg.—The municipality has been summoned by two parties for £100 and £80 damages respectively, in consequence of collisions between Corporation cars and a lorry and a trap, which resulted in the loss of a mule and a pony. The magistrate, however, gave judgment for the city in each case.

Stirling.—At a meeting of the shareholders of the Stirling and Bridge of Allan Tramways Co., the chairman said that certain offers for the purchase of the company's undertaking had been received, and it had been agreed to accept an offer of the National Electric Construction Co., subject to their being able to obtain the necessary agreements with local authorities and legislative power.

Walkden.—Two cars on the South Lancashire Tramway Co.'s system came into collision on Friday last, and both were damaged, but fortunately no one was seriously injured.

West Ham.—An agreement has been come to for the through running of cars over the West Ham and Leyton systems.

TELEGRAPH and TELEPHONE NOTES.

American Cyclones.—A cyclone in Havana and Florida of great violence caused much damage to the telegraph lines, the effect of which was to cut off communication "*vid* Key West" for about three days. Messages between Miami and Jacksonville in Florida had to be forwarded by train. The Direct West India Cable Co. gave notice in the Press that their lines were working well and that they were able to reach as far as Cienfuegos. This shows the value of "all cable" routes. Telegraph lines in Central America were also much damaged, but a Reuter dispatch of 22nd inst. states that the lines to the interior of San Salvador are being restored.

Brighton.—The T.C. has adopted the report of the Telephones Committee on the sale of the undertaking to the P.M.G. for £49,000, of which Hove is to receive £500 in respect of the ducts in that borough.

Canada.—During a heavy snowstorm on 11th inst. an immense amount of damage was done to the property of the Bell Telephone Co. at Niagara Falls. In one part of the city every pole for 2,000 ft. of the main trunk line was broken, and one of the principal streets was blocked with wreckage.

Cuban Telegraphs.—The *New York Herald* has given prominence to the formation at Albany, New York, of the Commercial Cable Co. of Cuba, formed for the purpose of laying two cables from Florida to Key West, and thence to Havana, to compete with the Western Union Co.'s cables. It appears that the 40 years' concession granted to the Western Union Telegraph Co. by Spain expires on December 6th next, and the Commercial Co. propose to open their cables for traffic on the next day, December 7th. Various attempts were made by the Commercial Cable Co. to persuade the United States Government to rescind the order of Mr. Alger, Secretary of War, to General Brooke to stop them from laying the cables, but Mr. Root refused the application. The capital of the new company is $100,000, or £20,000, and the directors are: Messrs. C. Mackay, W. W. Cook, Albert B. Chandler, Dumont Clarke, Samuel S. Dickinson, George Clapperton and Albert Beck. Special wires from Florida to New York City are to be erected to provide a quick service. Various reports have appeared from time to time of the intention of the United States Government to lay cables to Cuba, the Isthmus of Panama and Puerto Rico, and the action of the Commercial Cable Co. seems to show that the traffic to be expected from places in the West Indies and Central America, when the canal has been opened, will be very valuable. The British Government does not appear to encourage the laying of cables in this part of the world, but we think, in view of the future importance of this trade route, that every step should be taken to secure uncontrolled telegraphic facilities, and in this effort the Government should receive the active support of Canada, whose future will largely depend upon facilities owned equally with its neighbouring trade rival. The safety of the British and Colonial fleets and merchant shipping in the Caribbean will largely depend upon reliable advices in times of war.

Grand Trunk Pacific Telegraphs.—The first pole of the Grank Trunk Pacific Telegraphs was erected on September 14th at Portage la Prairie with appropriate ceremony. The Union Jack was hoisted and saluted by the firing of guns and hearty cheering by the workers who had gathered round. It is expected that a portion of the line will be operated next year. It is being erected at the rate of about two miles per day.

Russia.—Recent developments in the Russian telegraph service foreshadow the time when it will be possible to send direct wires from Edinburgh, Dublin, and London, to St. Petersburg and Moscow, without disturbing the intervening local telegraphic traffic, and this might lead eventually to a direct overland route to India.

At present there are 16 Wheatstone circuits working in Russia, the principal ones being between Omsk and Irkutsk, a distance of 1,200 miles (two transcribing stations); Kazan and Omsk, 1,100 miles (1 ditto); St. Petersburg to Rostow (2 ditto); St. Petersburg, 1,000 miles, to Odessa (2 ditto). The longest line is one of 3,200 miles; this is the direct line from St. Petersburg to Irkutsk. There are no intermediate posts in this case, and a special 6 mm. wire is used.

Recently the Government has adopted the Murray system, which has been working for the last two years between London and Edinburgh and Dublin respectively, and also between Hamburg and Berlin, and which, by the way, is being adopted for a duplex line from Calcutta to Bombay, and for another from Vienna to Prague.

As the experiments between Berlin and Moscow were of highly satisfactory character, it follows that only the link between London and Hamburg is required to bring about the result above indicated.

As an experiment, the Murray automatic telegraph printer was used in connection with the Baudot code on the line St. Petersburg to Moscow, a distance of 1,770 kilometres, with two intermediate stations. A 5-mm. iron wire was used. From recent reports it appears that while previously by using the automatic Wheatstone apparatus and the Morse alphabet 55 words per minute were transmitted, it was possible with the Murray apparatus to transmit 90 words per minute. The installation was then enlarged so as to comprise the following circuit: St. Petersburg, Jaroslav, Kazan, Moscow, St. Petersburg, the sub-stations being Jaroslav, Kazan, and Moscow. The total length is 3,082 kilometres. The efficiency obtained is 56 words per minute, as against 35 to 40 on the previous system, which constitutes a record for telegraph printers on such a distance. Finally, an experiment was made with a direct communication between St. Petersburg and Moscow without transcription, a distance of 1,280 kilometres. Again, a 5-mm. pure iron wire was used, with a resistance of 7,100 ohms on the line, and of 8,000 in the relay of the receiver, a battery of 140 volts and a current of 13 milliamperes. The result with the Murray printer and the Baudot alphabet was 63 words per minute, against 25. Ten printed messages were transmitted per minute without a single error.

Another experiment which gave even better results, 70 words per minute, was made between St. Petersburg and Berlin.

The line on the Russian side consisted of 600 miles of 5-mm. iron wire, and that from the frontier (Eidtkuhnen) to Berlin of a 3-mm. copper wire (4·37 ohms per mile), the total resistance of the line being 7,425 ohms. It appears that the saving is attributed principally to the use of the Baudot alphabet, which is proportionally as 5 to 8 as compared with the Morse code.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1.)	.. Aug. 26, 1901 ..	..
Cayenne-Pinheiro	.. Aug. 13, 1902 ..	..
St. Lucia-Martinique	.. May 7, 1902 ..	..
Dominica-Martinique	.. May 7. 1902 ..	
,, Guadeloupe	.. Oct. 12, 1906 ..	Oct. 15.
Guadeloupe-Martinique	.. Aug. 29, 1906 ..	..
Mole St. Nicholas-Port au Prince	.. Aug. 16, 1906 ..	..
Curacao-Coro Curacao-La Guayra } Closed	.. Jan. 12, 1906 ..	..
Curacao-Maracaibo		
Reissa-Issa and Reissa-Yemani (Yemen) ..	.. Oct. 22, 1902 ..	..
Tarifa-Tangier	.. Jan. 18, 1904 ..	..
Port Arthur-Chifu (Closed)	.. Mar. 9 1904 ..	..
Garachico Santa Cruz	.. July 12, 1906 ..	..
Las Palmas-Arecife	.. Aug. 18, 1906 ..	..
Landlines.		
Florida	.. Oct. 18, 1906 ..	Oct. 20
Cuba	.. Oct. 18, 1906 ..	Oct. 20
Puerto-Barrios	.. Aug. 28, 1902 ..	..

Wireless Telegraphy.—In the course of an article by Herr A. Furst, which was published in a recent issue of the Berlin *Tageblatt* in reference to a visit paid to the wireless telegraph station at Nauen, which is not many miles distant from Berlin, it is stated that the station is able to communicate with safety over a distance of 1,550 miles, and the opinion is expressed that the time is not very remote when it will be possible to telegraph to New York. Specially interesting is the statement that the engineer in charge of the station on the occasion of the visit remarked that he would endeavour to ascertain whether the "brothers" at Poldhu

were telegraphing at the time. Shortly afterwards the Morse instrument began to work, and the dots and dashes on the paper strip, it is said, indicated English words which, however, revealed no sense. Nevertheless, the author observes that it was ascertained that the telegrams were in cipher, and were being sent by the English Admiralty to the cruiser *Carmania* at sea. When the Nauen station does not understand anything sent out by Poldhu, the former produces its wave measuring apparatus, and by this means ascertains in a very short time the wave length at which the English station is working. The Nauen receiving apparatus is set accordingly, and the secret is one no longer. It is understood, Herr Furst states, that the people at Poldhu act in a similar manner. The Nauen station is 325 ft. high, and the proprietary company is credited with the intention of erecting a second tower which will be 975 ft. high, or as high as the Eiffel tower.

The experiments which have been for some time under way with a view to establishing wireless telegraphic connection between Fiume, Ancona and the neighbouring islands in the Adriatic have been so far satisfactory that a permanent installation has been decided upon. The experiments were made at the instigation of the Ministry of Commerce of the Dual Monarchy, under the direction of Herr Joseph Hollos, consulting engineer to the Post and Telegraph Department, one of whose improved apparatus was employed in the experiments.

Wireless Telegraph Conference.—On Saturday last the City of Berlin gave a reception in honour of the delegates to the Conference.

CONTRACTS OPEN and CLOSED.

OPEN.

Beckenham.—October 29th. Induced draught apparatus for the U.D.C. electricity and destructor works. See "Official Notices" October 5th.

Cape Town.—November 28th. Tenders will be received by the Chairman of the Tender Board, Cape Town, for the supply of dry cells, oblong, 3 in. by 1¾ in. by 6 in. high, regenerative or non-regenerative type, for the period February 1st to October 31st, 1907.—*Board of Trade Journal.*

Cleckheaton.—October 29th. One 82-KW. motor-generator with switchboard and accessories for the Council. See "Official Notices" October 19th.

Erith.—October 29th. Water tank, water-purifying and softening plant, feed pump and pipework; removal and re-erection of existing condensers, feed pumps, pipework, &c. See "Official Notices" October 12th.

G.W. Railway.—October 29th. Stores for one year. See "Official Notices" October 12th.

Hackney.—November 22nd. One 1,500-KW. steam dynamo with accessories. See "Official Notices" to-day.

Hungary.—November 15th. The municipal authorities of Veszprem are inviting tenders for the establishment of a central electric lighting station in the town.

London.—November 5th. Sundry fittings and stores for the L.C.C. See "Official Notices" October 19th.

Manchester.—October 31st. One 5,000-KW. turbo-alternator complete with condensing plant, for the Corporation. See "Official Notices" October 5th.

Northampton.—October 29th. 1,500 tons of steam coal for the Corporation. See "Official Notices" October 19th.

Portsmouth.—November 5th. Electric pumping, &c., plant in connection with the works for the prevention of storm water flooding at Southsea. See "Official Notices" October 12th.

Spain.—October 29th. The municipal authorities of Linares (province of Jaen) are inviting tenders until the 29th inst. for the concession for the electric lighting of the town during a period of 12 years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Linares (Jaen).

Spain.—October 31st. The municipal authorities of Pontevedra are inviting tenders until the 31st inst. for the concession for the electric lighting of the town during a period of 15 years. Tenders are to be sent to El Secretario del Ayuntamiento de Pontevedra, whence particulars may be obtained.

Spain.—November 3rd. The Government invites tenders as follows:—For (1) an electric tramway in Barcelona, starting in the Calle Dalmesses, and passing through the following streets: Ganduxe, Cortes, Negrovernis, and ending in the Copernico and Muntane Streets; and (2) for the concession to construct and work an electric tramway in Barcelona, from Escorial to Fuente Castellana Street, passing through the Piaza (Square) Josepets. Particulars may be obtained by registered letter from the Direccion General de Obras Publicas, Ministerio de Fomento, Madrid. Local representation is required.

Swinton and Pendlebury.—November 3rd. Sub-station buildings, low tension switchboard, mains, and meters for the U.D.C. See "Official Notices" October 19th.

Woodstock (Cape of Good Hope).—November 28th. According to a notice in Wednesday's *Times* the Corporation is inviting tenders for the public lighting of the town for five years. London agents:—Messrs. J. C. Mackinlay & Co., 27, Wallbrook, E.C.

CLOSED.

Bolton.—The Corporation Electricity Committee has accepted the following tenders:—

British Insulated & Helsby Cables, Ltd.—Scrap copper.
Musgrave & Son.—Steam bend piping.
Talbot & Son.—Erection of supply station in Green Lane.

Brighton.—The T.C. has accepted the tender of the Reason Manufacturing Co., Ltd., for the supply of 100 electrolytic meters, at 25s. each, with a five years' guarantee.

Burnley.—The T.C. has accepted the tender of Messrs. E. Bennis & Co. for one of their stokers for a new 30 ft. × 8 ft. Lancashire boiler.

Brynamman.—The Brynamman & District Electric Supply Co. have placed an order for a battery of 118 600-ampere-hour cells with the D.P. Battery Co., Ltd., Bakewell.

Glasgow.—The Tramways Committee of the T.C. has accepted the following offers:—

Insulated bolts for Brooklyn insulators.—W. C Yuille & Co.
28-inch copper bonds.—United Steel Products Exports Co.
Nidged granite wheelers.—J. & A. Gardner & Co.
Canopy switch handles.—Consolidated Supply Co.
Controller bushings.—Consolidated Supply Co.
Bronze strip for fingers.—Consolidated Supply Co.
Transformers.—British Westinghouse Co.
Fans for sub-stations.—Electrical Co.
Cast-iron divisions for Whitevale Depôt.—James Allen, sen., & Sons.
Cloth for destination screens.—Adam Brand & Co.
Enamelled route plates.—William McGeoch & Co.
Car brake chains.—Todd Bros.; Weldless Chains, Ltd.
Additional panel for Whitevale switchboard.—British Westinghouse Co.
Spiral springs for trolley bases.—George Turton Platts & Co.

London.—HACKNEY.—The B.C. has placed an order with the Tudor Accumulator Co. for 3,000 positive battery plates, at 12s. each.

ST. PANCRAS.—The B.C. has received the following tenders for the supply of 148 arc lamps for street lighting extensions:—

British Thomson Houston Co.	£555	Improved Electric Supplies, Ltd.	£700
Rumney & Rumney	585	Brockie-Pell Arc Lamp, Ltd.	703
Johnson & Phillips	590	Ewart & Co.	722
Crompton & Co.	607	Veritys, Ltd.	729
Oliver & Co.	666	New Century Arc Light Co.	888
Gilbert Arc Lamp Co.	673	General Electric Co.	925
,, (alternative) (accepted)	755	Walsall Electrical Co.	1,221

The Electricity Committee reported that they were satisfied, from information given by the chief electrical engineer of the experience of the satisfactory results obtained from the Gilbert arc lamps, that those quoted for in the alternative tender of the Gilbert Arc Lamp Co., Ltd., were the most suitable for the Council's purposes.

L.C.C.—The Highways Committee have informed the L.C.C. that during the summer recess the seal of the Council was affixed to the contract, amounting to £1,702, with the Edison & Swan Co. for the supply of materials for the wiring of certain tramcar sheds and sub-stations, which is being undertaken by the tramways department.

MARYLEBONE.—The B.C. has accepted the tender of Messrs. Cory & Son, Ltd., for the supply of coal required for the generating station during the next 12 months on the following terms:—

Shipley double screened nuts (1) by rail, 12s. 9d.; (2) by water, 12s. 1d.
Griff peas (1), 11s. 7d.; (2) 10s. 11d.
Cowdenheath double screened nuts (2), 13s. 3d.
Acton Hall and Methley washed nuts, (2), 14s. 3d.

The B.C. is to purchase 5,000 maximum demand indicators from the Reason Manufacturing Co. for a net sum of £7,610. By his agreement with the Council the consulting engineer (Mr. Wright) will refund to the Council any royalties or other benefit which he may receive by virtue of his interest in the Reason Manufacturing Co., Ltd.

London United Tramways.—The contract for the overhead line equipment for the Wimbledon extensions of the London United Tramways (per Mowlem & Co.) has been placed with the Brush Electrical Engineering Co., Ltd.

Southend-on-Sea.—The T.C. has accepted the tender of Callender's Cable & Construction Co., Ltd., for the supply of extra cable, and that of Messrs. Körting Bros. for an automatic exhaust valve for the new 500-KW. engine and dynamo.

FORTHCOMING EVENTS.

To-day's Events (Friday, October 26th).—At 7.30 p.m. N.E. Coast Institution of Engineers and Shipbuilders. At Westgate Road, Newcastle-on-Tyne. Presidential Address by Mr. W. H. Dugdale.
At 5 p.m. Physical Society. At Royal College of Science. Mr. W. A. Scoble on "The Strength and Behaviour of Ductile Materials under Combined Stress." Mr. J. M. Baldwin on "The Behaviour of Iron under Small Periodic Magnetising Forces." (Communicated by Prof. Trouton.) Prof. R. W. Wood on "Fluorescence and Magnetic Rotation Spectra of Sodium Vapour, and their Analysis."

Saturday, October 27th.—At 3 p.m. Association of Teachers in Technical Institutes. Annual general meeting at the Birkbeck College, London.
Northampton Institute Engineering Society. Visit to G.E. Railway Co.'s Stratford works.
Monday, October 29th.—Institute of Marine Engineers. Lecture on Fuel Testing.
Thursday, November 1st.—At 8 p.m. Civil and Mechanical Engineers' Society. Mr. P. J. Waldram on "Bridge-work Design."
At 8.30 p.m. Chemical Society. Meeting.
Friday, November 2nd.—At 8 p.m. Junior Institution of Engineers. Presidential address by Mr. Wm. B. Bryan on "Water Supply."
Northampton Institute Engineering Society. Mr. A. Sterling on "Electrical *v.* Mechanical Power in Factories."
Saturday, November 3rd.—Association of Engineers-in-Charge. Dance.

NOTES.

Institution Notes. — Glasgow Technical College Scientific Society.—Mr. W. W. Lackie, chief electrical engineer to the Glasgow Corporation, delivered the opening address of the session last Saturday. The electricity generating stations of Glasgow, he said, had plant and mains capable of delivering 20,000 amperes at 250 volts, and 3,000 amperes at 6,500 volts, representing a total of over 40,000 H.P. In the supply of energy to the tramway system, it had been found that while each car was equipped with two 35-H.P. motors and frequently took this power, and the aggregate horse-power of motors on all the cars amounted approximately to 45,000 H.P., this possible demand was met by 8,000 H.P., or 17 per cent. of the whole. In the electricity supply to private consumers, while the total horse-power of motors applied for amounted to 12,000, the proportion of plant called upon to supply this did not exceed 4,000 H.P., or 33 per cent. In the supply of electrical energy for lighting purposes, the proportion was very different; while the horse-power required to supply the equivalent in 8-C.P. lamps applied for would be 40,000 H.P., it took 26,000 H.P., or 66 per cent. of the total to meet the possible demand. This factor explained why energy for power purposes could be supplied at a much lower rate than energy for lighting. The rate per unit was a very unreliable criterion as to whether the supply was cheap or dear. The consumer who was paying 3½d. per unit for lighting complained that he was being overcharged to make up the deficit caused by the consumer who was only paying ¾d. per unit for motive power; but it was the reverse that was the truth.

Institution of Electrical Engineers (Glasgow).—It has been arranged to hold the fifth annual dinner of the Section in the Banqueting Hall of the Grosvenor, Gordon Street, on Tuesday, November 27th. Lord Kelvin, G.C.V.O., chairman of the Section, has intimated his intention of presiding, and it is also anticipated that the Lord Provost of Glasgow will be present. The opening meeting of the Session takes place at 207, Bath Street, on Tuesday, November 13th.

The Students' Section has arranged to hold its meetings on the third Friday of each month at the Glasgow and West of Scotland Technical College. The first meeting of the session was held last Friday evening, when Prof. Magnus McLean delivered an address. He discussed elementary considerations regarding high frequency currents, the methods of producing the electro-magnetic waves used in wireless telegraphy and some of the apparatus available for detecting those electric waves, for measuring their wave-lengths and their frequencies. He showed in action a cymometer or wave-measurer, and wave-lengths up to 6,000 ft. were indicated by the instrument. He explained fully how the cymometer could be used as a laboratory instrument for determining inductances and capacities.

Institution of Electrical Engineers (Leeds).—Last evening at the University, Leeds, the presidential address of the Local Section was delivered by Mr. George Wilkinson, and Mr. R. H. Campion read a paper on "Overhead Equipment." A presentation was also made to Mr. G. R. Blackburn, who recently resigned the post of hon. secretary to the Section, owing to his removal to Manchester. The following is the programme of the 1906-7 Session:—

November 22nd.—At Sheffield University. Paper on "Regenerative Control of Electric Tramcars and Locomotives," by Mr. A. Raworth.
December 13th.—At Leeds University. Paper on "Practical Photometry and its Value," with practical demonstration, by Mr. H. Harrison.
January 24th.—At Leeds University. Paper on "Gas Engines and Suction Gas Plants," by Mr. H. Campbell.
February 21st.—At Leeds University. Paper read before other Section.
March 21st.—At Halifax Technical College. "Underground Mains," by Mr. W. M. Rogerson.
April 25th.—At Leeds University. Annual meeting.
May.—Excursion to the Yorks Power Co.'s works.
June.—Excursion to the Leeds Copper Co.'s works.
July.—Social Excursion. (In place of usual Annual Dinner.)

The Poulsen Wireless Telegraph Patents.—The new system invented by Herr V. Poulsen has been acquired by the De Forest Wireless Telegraph Syndicate, Ltd., which has formed a company to work it in connection with the De Forest and Maskelyne patents. The new company is called the Amalgamated Radio-Telegraph Co., Ltd., with Lord Armstrong as chairman.

Educational Notes.—To-morrow the annual general meeting of the Association of Teachers in Technical Institutes will be held at the Birkbeck College, at 3 p.m., to discuss the annual report of the Council, and to transact other business. Mr. W. J. Lineham, M.Inst.C.E., the President, will take the chair.

Wireless Telegraphy. — As mentioned in our last issue, a lively correspondence has been carried on in the *Times* during recent weeks on the subject of wireless telegraphy. The trouble began with a letter by Mr. J. H. Heaton, in which he denounced the summoning of the Wireless Telegraph Conference as an attempt to deprive Mr. Marconi of his just rights. Prof. S. P. Thompson retorted with a scathing letter exposing this "outrageous distortion of the truth," and recounting the history of wireless telegraphy from its public demonstration by Prof. Lodge in 1894 to Marconi's transmission across the English Channel in 1899. Prof. Thompson challenges Signor Marconi's claim to priority, and his personal right to improvements effected at the cost of the British Post Office, and shows how Prof. Slaby, discarding all the devices employed by Marconi, and using only apparatus and methods previously well known, succeeded in signalling to a distance 50 per cent. greater than Marconi. In 1897 Sir Oliver Lodge introduced and patented the oscillation-transformer or "jigger," by means of which the range of signalling was enormously extended. The policy of the Marconi Co. is stigmatised by Prof. Thompson as that of the dog-in-the-manger; if, he says, Marconi's patents have been infringed, the company has the obvious legal remedy—if it dare face the ordeal. Referring to the "threats and bluster," "bounce and brag" of the Marconi Co., Prof. Thompson asks why Mr. Heaton does not "denounce the whole attempt as an infamous job on the part of the Marconi directors."

Sir W. H. Preece, in the same issue, corrects Mr. Heaton's history, with a reference to his own experiments of 1884-92.

In the following issue a different note is sounded, by Sir Edward Sassoon, who strongly enjoins caution and reserve at the Berlin Conference; citing the embarrassments and complications resulting from hard and fast international regulations in the domain of cable enterprise, and the absurd inequality of voting power possessed by this country—one vote, equal in value to that of any insignificant State—Sir Edward points out the dangers of giving sanction to a premature and not improbably disastrous international commitment.

In the *Times* of the 16th inst., Lord Kelvin referred with appreciation to the previous letters, and pointed out that as long ago as 1830, Prof. Joseph Henry obtained inductive effects, with static electricity, between independent circuits 30 ft. apart, with two thick floors and ceilings interposed. This was followed, at a long interval, by Sir Oliver Lodge's successful signalling over a distance of 150 yards in 1894, subsequently improved upon in 1896 by Signor Marconi to a distance of ¾ mile.

In the next issue the Marconi Co. appears upon the scene over the signature of Mr. J. D. Oppe, quoting Prof. Slaby's eulogy of Marconi's achievements, and denying that Mr. Marconi received financial assistance from the British Post Office. Mr. Oppe further cites a judgment of Judge Townsend in the United States upholding the novelty of Marconi's invention.

Mr. Nevil Maskelyne came forward on October 20th "to set forth the exact facts" as to the main issues before the Conference. These are: "That all systems of spark-telegraphy not only can, but do, intercommunicate at the present moment"; that "this country at present enjoys no such supremacy as some imagine"; and that "the Navy is not asked to give up any advantages it now possesses." In a nutshell, all wireless systems at this moment intercommunicate—by interference; shall they be compelled to intercommunicate by mutually exchanging messages?

Mr. Maskelyne is taken to task for his cocksureness (October 22nd) by "Briton," who says he has entirely ignored the main question at issue. This is, that wireless telegraphy being still in the experimental stage, with untold possibilities, the British Empire is being asked to give up all freedom of action and to hand over the future of wireless telegraphy to an International Bureau composed of representatives of Powers whose interests in the matter are trifling as compared with ours, and whose bent is possibly hostile to our aims. Mr. Heaton also replies to Prof. Thompson, repudiating the suggestion that he had been "put up" by the Marconi Co.

The *Daily Telegraph* of the 24th inst. publishes a warning as to the grave risk of British Imperial interests, now safeguarded by the Admiralty, being handed over to the mercies of an International Bureau, and calling attention to the free acknowledgment in the German Press of the fact that the conference was convened to check Marconi enterprise, and to benefit German commercial interests.

Our own view is that the time is not ripe for any engagements to be entered into which we may in vain regret in the future. While we have never supported the pretensions of Signor Marconi to occupy the position of inventor of wireless telegraphy, or approved of the policy of the Marconi Companies—which has nowhere been more severely criticised than in our columns—we are in agreement with those who regard the issues at stake as of Imperial importance, and we are convinced that any concession whatever to interests notoriously opposed to our own would be a vital error.

Appointments Vacant.—Senior lecturer and demonstrator of the Electrical Engineering Department of the University of Birmingham (£250); engineer with a knowledge of electrical plant for the Acton Public Baths (45s.); fitter and turner for Acton U.D.C.; electrical fitter for the Neath R.D.C.; mains and test room assistant (25s.), and switchboard attendant (20s.), for the Wimbledon electricity department.

Labour Troubles.—It is reported that at Birmingham on Tuesday a conference took place between the Engineering Trade Employers' Association and the operatives, who have made a demand for an advance of 2s. on the 36s. minimum, and of 5s. on piecework. The employers are stated to have given a blank refusal to the men's demand, and a strike is, therefore, probable. About 110,000 workmen are concerned.

The men base their claim upon the increased cost of living, and the general prosperity in the engineering trade.

Street Explosion. — On Wednesday morning a gas explosion occurred in Jamaica Road, Bermondsey, in a street box, and was followed by a fire, which was extinguished with sand.

Sheffield Corporation and the Local Electrical Trades.—The hostile feeling of local electricians against the Sheffield Corporation has at last taken practical shape, and they have commenced an action with a view to putting an end to the Corporation's carrying on the electric wiring and fixing department.

The *Sheffield Daily Independent*, in announcing this fact, says that the action raises in an acute form the whole question of municipal *versus* private trading. "It appears that the old electricity company had power under their articles of association to carry on a wiring and fitting department in addition to generating electricity, and when the Corporation purchased the undertaking they paid for that department something like £20,000. Naturally they have continued the business, and it has proved both satisfactory to consumers and profitable to the city.

"After a time, however, complaints began to be lodged that the Corporation were unfairly competing with private traders who were carrying on a similar business. The Corporation's reply was 'It is you who are competing with us, for the old company started first, and we have simply taken their business over.' Three years ago the Corporation promoted a Bill, and included an application for power to let electric motors out on hire. In order to avoid any future difficulty, it was intended at first to also include power to carry on wiring and fixing, but the opposition by local traders was so strenuous . . . . that the Corporation withdrew the part relating to wiring and fixing, and decided to rely on their powers as successors of the company. Ever since then the local electric traders have intermittently threatened to take proceedings against the Corporation for an injunction to prevent them continuing the department. . . . The officials had invariably obeyed the instructions that they were to limit the work of the wiring and fitting department to intending and actual customers."

The National Association has now commenced an action against the Corporation.

The Metric System.—The report that Messrs. Kynochs, Ltd., have adopted the metric system throughout their works, and a decimal system of coinage based on the pound sterling, indicates that the exigencies of a large export trade compel attention to the enormous inconveniences entailed by the survival of what Mr. Arthur Chamberlain calls our "benighted" systems of weights and measures. It is several years since Messrs. Mather & Platt realised the fact, and adopted the metric system; Messrs. Willans and Robinson were earlier still, but we believe they use it only for their foreign trade. There is no doubt that the question is acquiring greater prominence, and we may yet live to see this most desirable reform carried into effect—thanks largely to the efforts of the Decimal Association.

Electrification of the Heysham, Morecambe and Lancaster Railway.—Just as we go to press some particulars have come to hand regarding this scheme for the electrification of a section of the Midland Railway, which has been drawn up by Mr. R. M. Deeley, locomotive superintendent, and his assistant, Mr. Dalziel, electrical engineer; the details of the line equipment being in the hands of Mr. Worthington, engineer-in-chief, and his assistant, Mr. Sayers. The length of the line is about 8 miles of double track, on the single-phase overhead system, with 6,600 volts on the line and step-down transformers on the motor coaches. The contract for the generating station has not yet been given out. The power will probably be provided by an extension of the existing station at Heysham (fully described in the ELEC. REV. for Nov. 4, 1904), which already contains three 150-KW. gas engine sets and a battery, for supplying the lights, cranes, &c, in the harbour. So far as arranged, the rolling stock will at first comprise three motor coaches and four trailers. The portion of the contract which has been awarded to Messrs. Siemens Bros.' Dynamo Works, Ltd., comprises one motor coach and two trailers, together with the controllers and wiring. The motor-coach will be equipped with two Siemens patent compensated series single-phase motors, with special commutation poles. The rated output of each motor is 180 H.P., and the efficiency is about 83 per cent., including gear losses. The power factor is about 92 per cent. The motor-coach will be provided with a main transformer, delivering 320 volts to the motor terminals. The primary side of this transformer is controlled by an electrically operated main switch, which is opened by the master controller when in the "off" position. For starting, the voltage on the motors is varied by connecting them to various tappings on the transformer, by means of electrically operated contactors, placed under the cars and controlled by the driver. The motors are connected to the car axles through single reduction gearing—ratio 40 : 118—the driving wheel on the car axle being 43½ in. in diameter. The motors are mounted on the bogie by centre-of-gravity suspension, the standard bogies being suitably modified by the Midland Railway.

The current for lighting, heating and control purposes is derived from an auxiliary transformer, which is always connected to the line, and serves also to supply power for the control circuits. The lighting and heating equipment are being carried out by the Midland Railway. There will be a single trolley wire for each track, supported by catenary suspension. Probably no feeders will be required, the current being supplied from the Heysham end of the line only. The rails, which carry the return current, will be bonded and earthed at various places by connection to earth plates in the sea and river.

Motor-'buses and Tramcar Accidents in London.—From a return (see *Times*, October 18th) of motor accidents in the Metropolitan Police district during July and August, 1906, we gather the following figures relating to motor-'buses and tramways:—

	July.	August.
Accidents caused by motor-omnibuses	361	436
Number of these accidents which caused personal injury	74	75
Number of these accidents which proved fatal	1	5
Accidents caused by mechanically-propelled tramcars	286	317
Number of these accidents which caused personal injury	105	121
Number of these accidents which proved fatal	1	2

Zambesi Electricity Co.—It is stated on good authority (says the *Financial News* of yesterday) that the negotiations in connection with the constitution of the Zambesi Electricity Co. (the promotion of which was announced some time ago) are actively proceeding. "It is the intention of the promoters to build large electrical works on the Witwatersrand, using steam power to commence with, which, later on, is to be replaced by hydraulic power supplied by the Victoria Falls. We understand that the promoters propose raising the necessary share capital in this country, reserving an issue of debentures for the German market."

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.

Central Station Engineers.—The Bradford T.C. has declined to adopt a proposal to retain the services of Mr. BLACKMAN, electrical engineer, who has been appointed to a similar position at Sunderland, by offering him £800 a year, rising by £50 annually to £1,000.

Mr. HAROLD T. BARNES, of Worcester, and Mr. BERNARD W. GOTHARD, of Dover, have been appointed switchboard attendants at the Portsmouth Corporation electric lighting station.

Mr. G. S. DEARLING has recently resigned his appointment with the Hornsey Electricity Works, in order to join the staff of Messrs. Robert W. Blackwell & Co., Ltd., of Westminster.

Mr. RALPH LOMAX has been appointed chief electrical engineer at Stockport.

The Hoylake and West Kirby U.D.C. has appointed Mr. H. DARLING (of Sheffield), and Mr. H. STRINGER (of Watford), as switchboard attendants.

Mr. FRED. R. BURT, who has been employed as assistant engineer at the Aldershot Council's electric light works since they were opened, has left to take up an appointment at Harrow.

Mr. DAVID A. HAMILTON, who for the last five years has been chief assistant to Mr. W. A. Tester, electrical and tramways engineer of the Lancaster Corporation, has received an appointment with a London firm, and terminated his engagement at Lancaster. The staff presented him with a travelling bag, the presentation being made by Mr. Benson, who referred to the kindly relationship which had existed between Mr. Hamilton and the electricity employés. Mr. Tester also added his tribute to the capable services Mr. Hamilton had rendered in connection with the re-modelling of the works, and the installation of the tramway system.

A smoking concert was held at the Anchor Hotel, Wednesbury, on Wednesday, 17th inst., when Mr. A. B. HAWES was presented with a pair of binoculars by the works staff of the Midland Electric Corporation for Power Distribution, Ltd., on the occasion of his leaving to take up a position as chief assistant electrical engineer under the Government at Lagos, West Coast of Africa. The chair was taken by the resident engineer, Mr. G. R. J. Parkinson, who made the presentation. The position vacated by Mr. Hawes has been filled by Mr. R. W. JOHNSTON from the mains department.

Mr. H. PARKER, third assistant engineer of the Corporation electricity works, Chesterfield, has obtained the post of junior assistant at the Wakefield Corporation electricity works. He was presented with a travelling bag by the staff before leaving to take up his new duties.

Mr. R. LORAINE GAMLEN having accepted an important appointment abroad, has resigned his position of engineer and manager to the Lancashire Electric Power Co.

General.—The staff of the metropolitan office of the National Telephone Co. have presented an American roll-top desk and chair to Mr. C. F. MOORHOUSE, who is leaving to take charge of the Sussex district.

Fulham B.C. has appointed Mr. T. H. MOORE, third-class clerk at the electricity station, to be collector of electric lighting accounts, at a commencing salary of £150 per annum, rising by annual increments of £10 to £200. There were 63 candidates.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

New Phonopore Telephone Co., Ltd. (London) (44,654).—A mortgage dated September 10th, 1906, to secure an unspecified amount, but stamped to cover £2,500, charged on the company's freehold property at Southall, and the unissued capital, has been registered. Holders: Barclay and Co., Ltd., 54, Lombard Street, E.C.

W. T. Glover & Co. Ltd. (Electric wire and cable makers, Manchester) (56,124).—A memorandum of satisfaction (*a*) in full of second debentures, bearing various dates from May 7th, 1902, to April 6th, 1905, securing in all £100,000 and (*b*) of £16,100, secured by a trust deed dated April 6th, 1906, has been registered.

Electric Vehicles Development Co., Ltd. (London) (90,213).—Issue on September 26th of £1,410 4 per cent. debentures, part of series created same date to secure not more than £3,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees.

Eastern and South African Telegraph Co , Ltd. (13,306).—This company's annual return was filed on August 15th, when the entire capital of £600,000 in £10 shares had been taken up and paid for in full. Mortgages and charges: £485,400.

Electrical Oil Refining Co., Ltd. (43,126).—This company's annual return was filed on August 21st, when 4,375 shares had been taken up out of a nominal capital of £5,000 in £1 shares; £882 has been received, and £3,493 is considered as paid. Mortgages and charges: Nil.

Clarke, Steavenson & Co., Ltd. (57,821).—This company's annual return was filed on September 17th, when the entire capital of £3,000 in £1 shares had been taken up; £1 per share has been called up on 1,400, 15s. per share on 600 and 10s. per share on 1,000, resulting in the receipt of £2,350. Mortgages and charges: Nil.

Jandus Arc Lamp and Electric Co., Ltd. (43,898).—This company's annual return was filed on September 12th, when 2,041 shares had been taken up out of a nominal capital of £30,000 in £10 shares. £5 per share has been called up on 1,195 and £10 per share on 250, resulting in the receipt of £8,475. £5,960 is considered as paid on 596 shares. Mortgages and charges: £8,000.

Chilian Electric Tramway and Light Co., Ltd. (57,203).—This company's annual return, made up to August 8th, has been filed. The entire capital of £1,150,000 in 500,000 ordinary and 650,000 preference, has been taken up. £650,000 has been paid on the preference and £500,000 is considered as paid on the ordinary. Mortgages and charges: £500,000.

Chili Telephone Co., Ltd. (29,252).—This company's annual return, made up to July 26th, was filed on August 24th. 44,000 shares have been taken up out of nominal capital of £250,000 in 50,000 shares of £5 each. £5 per share has been called up, resulting in the receipt of £220,000. Mortgages and charges: £12,000 bonds to bearer.

CITY NOTES.

Kalgoorlie Electric Power and Lighting Corporation, Ltd.

At a meeting held at Winchester House on Monday, the directors submitted a proposal for dealing with the accumulated interest due to the preferred shareholders. They recommended that the business and assets of the present company be taken over by a new company with a nominal capital of 175,000 6 per cent. preference shares of £1 each, £175,000, and 100,000 ordinary shares of 10s. each, £50,000 = £225,000, to be distributed as follows to shareholders in the present company:—

	New company. 6 per cent. £1 preference shares.	New company. Ordinary shares of 10s. each.
To the holders of 150,000 6 per cent. cumulative preferred shares	150,000	—
,, ,, ,, ...	—	75,000
To the holders of 25,000 deferred shares ..	—	25,000
To be held in reserve for future issue ..	25,000	—
	175,000	100,000

In exchange for each £1 6 per cent. cumulative preferred share held in the existing company, each shareholder shall receive one fully-paid £1 6 per cent. preference share in the new company. For each two preferred shares in the existing company, one 10s. fully-paid ordinary share in the new company shall also be given. Such ordinary shares to be given in exchange for the rights to accumulated interest on the 6 per cent. cumulative preferred shares in the present company. In exchange for each £1 deferred share in the existing company, each shareholder shall receive one 10s. fully-paid ordinary share in the new company. The amount of the nominal capital of the proposed new company will be the same as in the existing company, with £25,000 of 6 per cent. preference shares available for future issue if required. The advantages claimed for these arrangements were:—

1. The preferred shareholders will retain the same amount of preference capital bearing interest at the rate of 6 per cent. per annum.
2. The arrears of interest on the preferred capital (which arrears arose during the period in which the plant and machinery were being elected and the business being built up) will be eliminated, and the preferred shareholders will receive a separate and additional security, taking 75 per cent. of the surplus profits, after payment of the 6 per cent. interest on their preference shares.
3. The deferred shareholders are benefited by the discharge of the large amount of accumulated interest which would have to be paid to the preferred shareholders (as the company is at present constituted) before any profits could be paid on the deferred shares. Under the new arrangement, the deferred holders will receive without delay 25 per cent. of any divisible profits of the company after 6 per cent. has been paid on the preference shares.

The new company will take powers to issue £60,000 debentures, out of which it will redeem the £33,000 of debentures issued by the existing company, and there will be a balance of £27,000 debentures for the new company to issue should the company's business make it advisable to do so. The business of the company is of a satisfactory character. The amount of power sold for the last six months (3,408,059 units) is considerably over the average of the sales for the previous year. The profit for the past six months is approximately the same as for the corresponding period of 1905, although the amount of power sold has been much larger. This is accounted for by the fact that certain alterations in the machinery were found to be necessary, so as to bring about further economies in the working of the plant. These have been carried out during the last six months, during which period the operation has involved an increased cost owing to the difficulty of carrying on the business while the alterations were being made and the new plant erected. This was of a temporary nature, and is now at an end, so that in future the working costs will show a material decrease. Another factor is that the directors have thought it prudent recently to reduce the charges to their customers.

Mr. R. W. Wallace, K.C., presided at the meeting, and said that with a view to explaining the need for the present scheme he had formulated a series of questions which would be raised by shareholders on such an occasion:—(1) Why the accumulated dividends were in arrear; (2) How the legal difficulty with regard to the dividends arose; (3) Could not reconstruction be dispensed with altogether; (4) Why no interim dividend was being paid at the present time; and (5) Was the scheme fair to all parties, and what would be its effect upon the prospects of the company? Into each of these questions the speaker entered in some detail. He moved the resolutions for effecting the carrying through of the scheme.

This was seconded by Mr. Pope.

There was a good deal of opposition to the proposal, and an amendment that the resolutions be "neither received nor adopted" was proposed from the body of the hall.

A number of shareholders gave voice to strong opposition, objecting, as one speaker said, to the confiscation of their cumulative rights. Another speaker asked that they should have cumulative preference shares in the new company for their cumulative preference shares in the old. In reply to a questioner, it was stated that the amount of the cumulative dividend unpaid was £45,000. Another member of the meeting stated his intention to fight the matter not only in the meeting but legally. Other speakers who followed argued in favour of the scheme, and the chairman having replied,

The resolutions were carried by 26 votes to 11.

Drake & Gorham, Ltd.

The directors' report for the year ended June 30th, 1906, says that after payment of all charges, including bonuses due to staff, there remains a net profit of £7,511, which, with the sum of £2,044 brought forward from the previous year, makes a total of £9,556, which it is proposed to appropriate by payment of a dividend at the rate of 6 per cent. per annum = £7,500, by placing to reserve £1,000 and by carrying forward £1,056. The reserve fund will then stand at £13,000. In determining the net profits an unusually large provision has been made in connection with outstanding accounts in view of the amount of work undertaken on deferred payment. Although the trade of the country is stated to have improved, the effects have not yet been felt in the electrical industry, and the directors, therefore, consider it satisfactory that they are able to recommend the same dividend as last year. The electrical equipment of the first cotton mill in Lancashire to discard its old plant in favour of electric transmission has been successfully put to work, and active steps are being taken to bring the results achieved to the notice of other millowners. Already the company has practically secured another important contract of the same class. The company has also been entrusted with the complete building and electrical equipment of a lace factory. The supply stations at Church Stretton and at Fochabers for the supply of the village continue to work satisfactorily. The additional premises for factory purposes, to which reference was made in the last report, have been secured and equipped, so as to enable a larger proportion of the company's requirements to be manufactured by their own staff.

Western Telegraph Co., Ltd.

The directors' report for the half-year ended June 30th, 1906, to come before the meeting on October 31st, states that the revenue for the period amounted to £314,555 and the working expenses to £104,578. After providing £15,448 for debenture stock and debenture interest and sinking fund, and £3,650 for income-tax, there remains a balance of £190,878; to this is added the sum of £5,269 brought forward from December 31st last, making a total of £196,148. A quarterly interim dividend, amounting to £31,191, has been paid, £75,000 transferred to the general reserve fund, £5,000 to the maintenance ships' reserve fund, £15,000 to a marine insurance fund, and £15,000 to a land and buildings depreciation fund. The directors now recommend a final dividend of 3s. per share, making with the interim dividends, a total of 6 per cent. for the year, and also the payment of a bonus of 2s. per share, both free of income-tax, which together will amount to £51,983, leaving a balance of £2,663 to be carried forward. The dividend and bonus will be payable on November 1st. The 5 per cent. debentures were duly redeemed on June 30th, 1906. The directors are grieved to report the sudden death of Mr. D. H. Goodsall on September 14th. Mr. Francis Alexander Johnston has been appointed to the vacancy. The register of transfers will be closed from October 23rd to 31st.

Ferranti, Ltd.

The directors' report to be submitted at the first annual general meeting at Winchester House, E.C., to-day, Friday, 26th inst., covers the period to June 30th, 1906. The company was incorporated on February 27th, 1905, and formally took over the property and assets from the receivers and managers and liquidator of the old company immediately thereafter. The trading account has been divided into two periods, viz., year to December 31st, 1905, and half-year to June 30th, 1906. The profits on trading, after payment of all establishment charges, have been as follows:—

Year to December 31st, 1905	£3,186 10 8	
Half-year to June 30th, 1906	5,179 2 1	
		£8,365 12 9
Deduct—		
Directors' remuneration and trustees' fees	£1,283 6 8	
Interest on first mortgage debentures ..	7,500 0 0	
Interest on bank loan	1,835 13 7	
Amount charged in respect of depreciation	5,250 0 0	
		£15,869 0 3
Loss for period		£7,503 7 6

While the results are unsatisfactory, it will be observed, from the accounts, that practically the whole of the loss occurred in the period to December 31st, 1905. This is due to the company having just emerged from a long period of management under the jurisdiction of the Court, and to the reorganisation of certain departments of the business. It was decided that in order to save expenses, and to consolidate the business of the company, the switch works should be vacated, and the plant and machinery erected in the shops belonging to the company previously devoted to engine building. This was effected in the last three months of 1905, and the results of the trading since that period justify the change and the partial disturbance of business. The works of the company are now in good order, and the amount of business which has been, and is being, carried out during the present year is encouraging. The requirements for sinking fund for the redemption of debentures have been debited against profit and loss as a charge for depreciation.

Stratford-on-Avon Electricity Co., Ltd.

The statutory meeting was held at Stratford-on-Avon on 22nd inst.

Mr. G. M. Bird, the chairman, stated that they had allotted 7,000 shares of £1 each (fully paid) to 44 subscribers. The contract for the whole of the works had been placed with Messrs. Johnson & Phillips, Ltd., and they felt that under the strict supervision of their own engineer, Mr. C. D. Falcke, they were in perfectly safe hands. They had taken a lease of land for 42 years in Arden Street from the Stratford-on-Avon Corporation, where they would see an immediate start made with the erection of the buildings for the generating station. Cables to the value of about £800 were now on the railway, and a staff of men would commence laying these in the course of a week or so. The contractors expected to be finished by the end of February next, so that early in March supply should be available. The directors could foresee a greater demand for electric power than they originally anticipated, and they had decided to take up the work of wiring and fitting up consumers' premises themselves. The chairman remarked that their capital account was very much smaller than those of many similar undertakings elsewhere in towns of the size of Stratford-on-Avon, which was a good feature; at the same time they were prepared to consider applications up to the full extent of the contemplated original issue of £9,000. The directors would probably soon make a further call on the shares.

Franco-Belgian Tramway Investments.—It is stated in the report of the Trust Franco-Belge de Tramways et d'Electricité, which relates to the financial year ended June 30th, 1906, that the company has participated in various new enterprises during the year, including the Beyrout Electricity and Tramways Co., and that the company has been entrusted with the execution of important works, of which the conversion of the Athens and Piræus tramways represents an instance. The control of the works in connection with the projected Beyrout tramways has been given to the company jointly with the Société l'Enterprise Générale de Travaux, of Liége, which was also one of the founders. The tramways at Athens and the Piræus will comprise 40 miles of line, having a track length of 62 miles, and the concession is for 42 years. In the case of the Smyrna tramways the trust holds the majority of the shares, and the company has paid 9 per cent. for the past year with the lines worked by horse traction. The report also refers to the tramways at Murcie, which are on the point of being started on the electric system, to the Sofia electric tramways, and to those at Reval and Tiflis. The internal situation in Russia has caused the Trust to postpone the extension and conversion of the Reval tramways. According to the accounts presented by the directors of the Trust at the recent meeting, the financial year has resulted in a net surplus of £5,185, which sum has allowed of the payment of a dividend of 3s. 2d. per share on the preference capital represented by 30,000 shares of £4 each, while the 30,000 ordinary shares do not receive any distribution.

Companies Struck Off the Register.—The undermentioned companies have been struck off the register, and are accordingly dissolved:—

Andrews & Preece, Ltd.
Corinthian Electro-Medical Battery Co., Ltd.
Dessolle Electro-Plating Co., Ltd.
Domestic Battery Syndicate, Ltd.
"Eclipse" Electric Lighting Syndicate, Ltd.
G. F. Milnes & Co., Ltd. (registered September 10th, 1898).
Humboldt Electric Power and Mining Co., Ltd.
Mining and General Electric Lamp Co., Ltd.
Mudge Marchant Engine Co., Ltd.
Norwich Mutual Telephone Co., Ltd.
Ward Electrical Car Co , Ltd.
Windsor and Eton Electric Light Co., Ltd.

Craigpark Electric Cable Co., Ltd.—The directors have declared an interim dividend for the six months ending September 30th last, at the rate of 6 per cent. per annum on the preference shares payable on and after November 10th.

Montreal Light, Heat and Power Co.—A dividend at the rate of 5 per cent. per annum has been declared for the three months ending the 31st inst.

Electrical and Mining Co. of Valdarno.—This company recently held its general meeting at Florence. The directors were able to report that the business undertaken had been of a profitable nature, enabling them to recommend a dividend of 4 per cent. on the ordinary capital. The revenue from the electrical installation at Castelno'vo amounted to 197,513 lire, and the working expenses to 34,224 lire. The company is also interested in the mining of lignite, and the directors propose to take steps further to develop this portion of their business in the immediate future. The board has recently been strengthened by the addition of Cav. Eng. Alessandro Scotti, who is well known as the chief engineer and manager of the Lombardi Co. for the electrical distribution of power.

Parsons Marine Steam Turbine Co., Ltd.—The report for the year ended June last states that the business continues to progress satisfactorily. Although the works have been fully employed during the period covered by the report, only a few contracts had been completed by June 30th. The amount of work now in progress is comparatively large, and it is expected that these contracts will be completed by the end of June next. The I.H.P. of turbine engines constructed by the company since the last report is 36,500; the I.H.P. of orders received by the company during the same period is 45,200; the I.H.P. of turbine engines constructed by the company's licensees is 93,780, and the I.H.P. of orders received by the company's licensees is 227,460, making a total since the commencement of about 870,000 I.H.P. The machine shop has now been extended by the addition of a large bay, which has been fitted with up-to-date machinery, to enable the company, as mentioned in the last report, to deal with the manufacture of the largest sizes of turbines. The accounts show a profit on manufacturing and from royalties, &c. (after providing for depreciation on buildings, plant and machinery, also on the patent rights account, &c.) of £19,221. The total distribution on the ordinary shares for the year has been 10 per cent., with £4,946 carried forward.

Stock Exchange Notice.—The Committee has appointed a special settling day as under:—

Tuesday, October 30th.—National Telephone Co., Ltd.—Further issue of 100,000 new shares of £5 each, fully and partly (£2 10s.) paid, Nos. 890,001 to 990,000.

City and South London Railway Co.—It is stated that the issue of £150,000 5 per cent. 1903 preference stock was over-subscribed.

West African Telegraph Co., Ltd.—The directors recommend an interim dividend at the rate of 4 per cent. per annum for the half-year ended June 30th.

Richardsons, Westgarth & Co., Ltd.—The report for the past year shows that the profits, after maintaining the buildings and plant in thorough repair, amount to £70,823. The directors recommend a dividend on the ordinary shares for the year at 6 per cent. per annum, £10,000 being set aside for depreciation, and £7,331 carried forward. The various departments at Hartlepool, Middlesbrough and Sunderland have been kept well supplied with orders, the contracts for which were taken under severe competition. Having regard to the increased cost of manufacture by reason of the advance in copper, pig-iron, and other materials largely used, as well as an unforeseen advance in wages, the results of the past year are regarded as highly satisfactory.

South Wales Electric Power Distribution Co.—The *Times* is informed "that the debenture holders of the South Wales Electric Power Co. have come forward with an offer to provide £500,000 if the consumers will guarantee to take 40,000 H.P." Our contemporary adds, "Considering the requirements of the district and the advantages of a central installation, it should not be difficult to obtain this guarantee."

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	Receipts for the fortnight. £*	No. of wks.	Total to date. £	Total to date. £*	Route miles open.	*
Aberdeen	Oct. 17	2,578	+ 34	20	32,248	+ 1,921	14·4	..
Ayr	,, 13	451	+ 24	22	8,891	+ 162	8	..
Bath	,, 17	1,624	+ 238	42	35,493	+ 6,412	13	..
Belfast	,, 19	6,893	+2,255	42	139,169	+43,861	40	+ 6½
Birkenhead	,, 21	2,188	+ 210	29	31,791	+ 743	13·52	..
†Blackburn	,, 17	2,044	+ 224	29½	31,818	+ 2,036	14·5	..
Blackpool Corp.	,, 18	1,444	+ 325	27	45,493	+ 3,339	11·87	..
,, —Fleetw'd	,, 20	838	+ 158	16	21,928	+ 3,557	8·25	..
† ,, —Lytham	Sep. 2	825	+ 155	39	12,897	+ 1,353	7½	..
Bolton	Oct. 21	4,216	+ 537	29	63,604	+ 5,002	26	+ 1
Bournemouth	,, 17	3,004	+ 467	28½	52,859	+10,407	18·75	+ 6⅔
Bradford	,, 20	8,837	+ 506	29	156,542	+ 5,712	53	+ ·7
Brighton	,, 21	1,235	+ 135	29	32,089	..	9·5	..
Bristol	,, 19	10,288	+ 601	..	..	..	28·5	..
Brit. Elec. Trac. Co								
Airdrie	Oct. 12	491	+ 55	41	9,144	+ 738	3·65	..
Barnsley	,, 12	330	+ 6	,,	6,725	+ 96	..	..
Barrow	,, 12	596	+ 129	,,	10,890	+ 766	5·87	..
Cavehill	,, 12	162	+ 89	,,	3,886	+ 1,746	..	..
Devonport	,, 12	1,108	+ 77	,,	19,086	— 65	8·85	..
Gateshead	,, 12	2,074	+ 156	,,	39,933	+ 2,214	11·25	..
Gravesend, N'fleet	,, 12	519	+ 65	,,	10,166	+ 486	6·5	..
Greenock	,, 12	1,348	+ 68	,,	28,127	+ 1,407	7·25	..
Hartlepool	,, 12	609	+ 42	,,	12,634	+ 1,549	6·72	..
Kidderminster	,, 12	208	— 7	,,	5,109	— 42	..	..
Leamington	,, 12	317	+ 7	,,	7,346	+ 2,647	3	..
Merthyr	,, 12	440	+ 53	,,	8,141	+ 294	2·9	..
‡Metropolitan	,, 12	7,341	+1,688	,,	142,287	+32,458	22	..
Middleton	,, 12	693	+ 65	,,	14,823	+ 643	8·5	..
Mid. Joint Com'tee	,, 12	20,126	— 270	,,	416,646	+16,365	..	..
Oldham — Ashton	,, 12	1,241	+ 82	,,	23,604	+ 682	9·13	..
Peterborough	,, 12	330	+ 48	,,	5,521	— 265	5·31	..
Potteries	,, 12	3,959	+ 317	,,	73,155	+ 3,626	29	..
Rothesay	,, 12	176	+ 11	,,	10,530	+ 1,594	2·75	..
Southport	,, 12	631	+ 58	,,	13,795	+ 455	8·17	..
S. Metropolitan	,, 12	954	..	35	11,759	..	..	..
Swansea	,, 12	1,798	+ 195	41	34,752	+ 5,252	5·5	..
Tynemouth	,, 12	459	+ 34	,,	11,277	+ 141	3·75	..
Weston-s-Mare	,, 10	207	+ 50	,,	7,106	+ 582	3	..
‡Worcester	,, 12	597	+ 15	,,	11,971	— 219	5·75	..
Wrexham	,, 12	232	+ 39	,,	4,337	+ 181	..	..
Yorks. Wool. Dist.	,, 12	1,867	+ 505	,,	37,401	+10,620	17	..
Miscellaneous	,, 12	226	..	,,	4,446	— 400	..	..
Burnley	,, 20	2,407	+ 289	41	..	..	7·5	..
†Burton-on-Trent	,, 18	301	+ 14	28	8,803	— 437	9·5	+ 1
Bury	,, 14	1,979	..	28	28,647	..	10·5	..
Cardiff	,, 13	4,204	+ 270	28	60,766	+ 448	15·87	..
Carlisle	,, 20	372	+ 35	42	7,927	+ 63	..	..
Chatham and Dist.	,, 18	1,617	+ 408	42	29,274	+ 1,129	12·84	+ 3·5
Cork	,, 18	971	+ 48	42	20,606	— 142	9·89	..
Croydon	,, 19	2,918	+ 536	20	31,925	+ 2,901	11·25	+ ·5
Darlington	,, 20	418	+ 35	29	6,302	+ 244	4·67	..
Darwen	,, 19	527	+ 52	29	7,582	+ 368	4·86	..
Dover	,, 20	477	+ 32	29	8,273	+ 1,143	4·75	+ 1½
Dublin	,, 19	10,142	+ 782	16	89,771	+ 5,202	18·75	+ ·25
Dundee	,, 17	2,301	+ 313	20	25,245	+ 4,810	13	+ ·5
East Ham	,, 20	1,771	+ 256	29	27,560	+ 2,676	8	+ ½
Exeter	,, 19	601	+ 130	29	9,103	— 18	4·75	+ ·5
Glasgow	,, 20	34,229	+3,367	23	348,852	+31,656	83·75	+ 8
†Halifax	Aug. 29	1,760	+ 89	22	33,419	+ 1,044	37	+ 1·5
Hastings	Oct. 19	1,665	..	..	..	..	..	..
†Huddersfield	,, 20	1,520	+ 225	29	45,468	+ 4,368	28	..
Hull	,, 20	6,024	+ 542	29	67,708	+ 2,177	13	..
Ilford	,, 20	908	+ 98	29	14,846	+ 236	6·37	..
Ilkeston	,, 18	266	+ 49	29	4,044	+ 479	3·5	..
Ipswich	,, 20	782	+ 78	29	13,738	— 3	10·5	..
Isle of Thanet	,, 20	875	+ 217	42	29,968	+ 939	11	..
Kilmarnock	,, 20	315	+ 39	23	3,788	+ 7	4·25	..
†Kirkcaldy	Sep. 26	296	+ 85	..	..	..	7·5	..
†Lan'kshire Trm. Co.	Oct. 18	880	+ 88	42	37,176	+ 6,165	12·56	+ ½
Leeds	,, 13	12,779	+1,073	28	180,359	+10,725	96	+ 6·5
Leicester	,, 20	4,641	+ 368	42	..	..	..	..
Leith	,, 13	1,048	+ 275	22	11,880	+ 5,029	6	+ 1
Liverpool	,, 13	22,680	+1,402	41	448,758	+ 9,048	104	+ 1
‡L.C.C.	,, 6	52,881	..	27	714,630	..	106½	+54⅔
London United	,, 19	12,226	+2,056	42	265,713	+20,715	..	..
†Lowestoft	Sep. 30	242	+ 38	52	9,901	— 416	3·5	..
Manchester	Oct. 20	28,523	+3,850	29	408,084	+29,467	146	+21
Newcastle	,, 20	8,426	+1,062	29	119,579	+ 8,191	25·5	..
Newport	,, 13	1,289	+ 176	28	18,429	+ 1,268	14·5	+ 1·5
Northampton	,, 19	835	+ 83	29	18,575	+ 969	5·5	..
Oldham	,, 21	3,711	+ 418	30	55,486	+ 5,586	23·75	..
Pontypridd	,, 20	332	+ 45	29	4,587	+ 171	3·5	..
Portsmouth	,, 20	3,495	+ 261	29	64,543	+ 243	14·5	..
Preston	,, 17	1,507	+ 284	..	..	..	10	..
Reading	,, 18	1,295	+ 159	29	19,154	+ 224	7·5	..
Rochdale	,, 20	2,035	+ 439	28	31,707	+ 8,746	20·6	..
Rotherham	,, 18	1,029	+ 131	29	14,714	+ 1,180	10	+ ·66
Salford	,, 15	9,208	+1,073	29	130,145	+ 4,360	38·9	..
Sheffield	,, 23	10,809	+1,334	30	160,396	+11,190	45·75	+ 1½
Southampton	,, 17	1,890	+ 106	28½	29,498	+ 497	..	..
Southend-on-Sea	,, 17	665	+ 101	29	13,642	+ 790	6	..
Stockport	..	..	..	..	..	..	..	..
Sunderland	,, 21	2,704	+ 302	29	42,597	+ 2,675	10·87	..
Tyneside	,, 17	1,027	+ 296	42	19,428	+ 1,861	8·87	..
Walthamstow	,, 20	1,008	+ 227	29	18,859	..	10	..
West Ham	,, 18	4,622	+ 702	29	67,448	+15,256	14·7	+ 1·4
Wolverhampton	,, 17	1,765	+ 266	29	25,202	+ 1,169	12·5	..
Yorks. W. Riding	,, 21	1,678	+ 184	42	35,165	..	..	..
Baker St.-Waterloo	,, 20	3,445	..	16	22,910	..	3·75	..
Cen. London Rly.	,, 20	13,030	— 807	16	91,508	— 4,240	6	..
City & S. Lon. Rly.	,, 21	5,686	+ 149	16	40,849	+ 2,235	6·25	..
Dublin-Lucan Rly.	,, 19	212	+ 4	16	2,217	— 35	7	..
G. N. and City Rly.	,, 20	3,637	+ 282	16	26,003	+ 1,843	3·5	..
L'pool Overh'd Rly.	,, 21	2,882	+ 2	16	24,464	— 560	6·8	..
Mersey Railway	,, 20	3,538	+ 280	16	26,647	+ 2,039	4·5	..
Metropolitan Rly.	,, 21	30,952	..	16	233,793	..	70·5	..
Met. District Rly.	,, 21	16,187	+ 197	16	118,988	+10,160	24	..
Anglo-Argentine	,, 21	32,957	+ 4,848	42	629,468	+71,447	43	..
§Auckland	,, 12	9,828	+ 715	40½	99,834	+ 6,748	19·24	+ ·6
§Brisbane	Sep.	11,579	+ 995	..	..	..	..	..
§Brit. Columbia Rly.	Aug.	23,139	+2,982	8½	44,979	+ 5,740	..	..
Bu'n's A'r's E.T.Co.	Sep. 22	2,624	+ 185	38	..	..	24	..
Bu'n's A'r's-Blgr'no	Oct. 14	7,936	+ 255	41	148,149	+ 6,695	..	..
Calcutta	,, 20	5,781	+ 748	..	..	..	..	..
§Cape Electric T. Ld.	Sep.	13,599	..	..	..	..	..	..
§Geneva	,,	8,782	+ 352	..	..	..	..	..
§Kalgoorlie, W.A.	,,	4,106	..	39	38,998	..	20·5	..
Madras	Oct. 15	1,089	+ 200	41	19,107	+ 2,117	10·5	+1½
§Lisbon	Sep.	25,945	..	..	..	..	..	..
§Mexico	,,	74,400	..	..	..	..	..	..
Perth (W.A.)	Oct. 19	2,808	+ 127	42	60,971	+ 3,503	24·25	+5

* Compared with the corresponding period of 1905. † One week only.
‡ Includes horse, steam and other receipts. § One month.

STOCKS AND SHARES.

Tuesday Evening.

Five per cent. Bank Rates, it was remarked here last week, gave the markets some difficulty in pursuing the cult of cheerfulness. Now the Bank Rate is 6 per cent., and the extra burden adds considerably more than 1 per cent. to the aforesaid burden. The banks advertise that they will pay 4 per cent. for money left with them upon deposit, and good customers can get 4 per cent. without much haggling. This being so, what temptation is there for investors to buy stocks and shares in the present state of uncertainty? Of course the rate will not remain at 6 per cent. for long, but at present the prospect points to its unwelcome presence being with us until the end of the year, and a more chilling influence to business, short of a yet higher rate, cannot well be imagined.

However, it is here and must be endured with what firmness the markets can command. That this has not been lacking, a glance down the list of electricity supply shares is sufficient evidence. Out of the 61 prices quoted in our list, 58 are unchanged. The three alterations are declines of 5s. in Chelsea Ordinary and Edmundson's to 5¼ and 3¼ respectively, and a fall of 10s. in City Lights to 11½. Of course the reason lies rather in the absence of business than in the inherent strength of stocks, but the general steadiness would seem to show that proprietors of electricity supply issues are content with their holdings, and see no reason why they should be flurried out of them because of a scare in the money market. On the other hand, prices should advance at this particular season of the year, but we cannot concede their refusal to do so as a moral decline.

No information is available up to the time of writing as to the precise reception accorded to the new issue of City and South London Railway Third Preference, particulars of which were given in our last issue. The prospectus appeared at a peculiarly unlucky time, in view of the rise in the Bank Rate, of which alteration the directors, of course, had no inkling in advance. It is said, however, that the stock was well over-subscribed. Business has been done at 1 to 2 premium. City and South London Ordinary stock fell a point to 43, and it is surprising that the drop went no further, seeing that the new security pays about 2s. 6d. more on the money than the Ordinary at the present rate of dividend on the latter. But the hope naturally runs that the Ordinary dividend will be increased as the extensions come into working order.

Baker Street and Waterloo debenture is somewhat harder at 91½, the traffics beginning to look more substantial. Districts at 20 and Metropolitans at 60—business has been done at lower prices in each case—went flat with the rest of the Home Railway market, which had the raised Bank Rate to contend with, besides the opening of another session of Parliament, in which Labour members are conspicuous. The progress of the trams on the Embankment is another cause put forward to account for the weakness in Districts. A fall in London and South-Western stocks made the Waterloo and City price shed a couple of points, and part of the quotation has fallen below 100.

Telegraph stocks and shares are active, though in the wrong direction for holders. The Anglo-American Telegraph Company's trio dropped in consonance with the slump in Yankee Rails at the beginning of the week. Submarine Cables Trust are 2 lower, and Direct United States shares lost ⅛ at 15⅞. Eastern Telegraph Ordinary came down rather sharply, and the price is 2½ flatter at 142, while Eastern Extensions remain at 14. Cuba Telegraphs shed the ⅛ they gained a week ago, and a further small fall occurred in Western Telegraphs. Globes have not altered. The dull tone prevailing all over this section is due to the monetary stringency, and the only advances are in Cuba Telegraph Preference (despite the decline in the Ordinary), and in the senior issues of the Direct Spanish Telegraph Company.

This dulness has spread to the Telephone varieties. National Deferred is down 3 to 107, and the Preferred 1 to 109. The Third Preference at 5½ lost ⅛, and the 4 per cent. Debenture at 101½ is 1½ lower. So that those who took our little hint as to the value of the *Daily Mail's* statement concerning a new system of payment for telephone service, will not be complaining at our implied caution against buying the securities upon our contemporary's "information."

Monte Video Telephone shares have again advanced a shade, while Chili Telephones remained at 7.

The Traction and the Manufacturing lists are well-nigh colourless. British Electric Tractions fell to 4¼, the Preference to 8 and the Second Debenture to 91½, losses of 5s., 10s. and 50s. respectively. London United Tramways Preference are down to 9, and the Debenture to 92½. Potteries 4½ per cent. Debenture hardened a point to 102½. Sao Paulo Tramway Light and Power stock is 136½, and the 5 per cent. Debentures marked 99¾.

Of the Manufacturing shares, one of the few only quotable changes is a decline to 3⅞ in Babcock & Wilcox. British Aluminium are harder at 5 15/16, and Westinghouse Preference at 30s. Monday's meeting of the London Motor Omnibus, Vanguard, Company brought about no change in the price of the Ordinary shares, but the 6 per cent. Preference have found buyers willing to pay a fraction under 4 for the fully paid £5 shares.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. †	Dividends for the last four years. 1902.	1903.	1904.	1905.	Closing Quotations Oct. 16th.	Closing Quotations Oct. 23rd.	Business done week ended Oct. 23rd, 1906. Highest	Lowest.	Rise + or Fall —
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	3⅞ — 4¼	3⅞ — 4¼	..	..	..
155,600	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	Nil	5 %	84 — 93	88 — 93	..	..	..
702,600	Anglo-American Telegraph	Stock	60/6	61s.	32½ %	34½ %	65 — 67 xd	64½ — 66½	65½	..	— ½
3,148,700	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5½ %	6 %	110½—111½xd	109⅜—110½	111½	110½	—1
3,148,700	Do. do. do. Deferred	Stock	1/-	2s.	Nil	1½ %	24¼ — 24½	23⅛ — 23⅜	24⅜	23½	—1½
50,000	Anglo-Portuguese Tel., 5% Mort. Deb. Stock Red.	100	..	..	..	..	101 —103	101 —103	102	101⅜	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	8 %	8 %	6¾ — 7¼	6¾ — 7¼	..	..	..
1,922,856	Commercial Cable Sting. 500 year 4 % Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	97 — 99	97 — 99	98	97⅜	..
16,000	Cuba Telegraph	10	6½%	10 %	5 %	5 %	8⅜ — 8¾	8½ — 9	8⅝	..	— ⅛
6,000	Do. 10 % Pref.	10	10 %	5 %	10 %	10 %	17 — 18	17½ — 18½	18	16	+ ½
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	8⅜ — 8⅝	8⅜ — 8⅝	..	..	..
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8⅞ — 9½	8⅞ — 9⅜	..	..	+ ⅛
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	98 —102	99½—102½	..	..	+ 1
60,710	Direct United States Cable	20	3½%	3 %	3½%	4½%	15⅞ — 16¼ xd	15⅞ — 16 xd	16½	15⅞	..
65,500	irect W. India Cable, 4½ % Reg. Deb., 1 to 1,200,R.	100	4½%	4½%	4½%	4½%	100½—102½	100½—102½	..	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	143 —146 xd	140½—143½	145	141	—1½
2,000,000	Do. 8½ % Pref. Stock	100	8½%	8½%	8½%	8½%	89½— 91½ xd	89⅜— 91½	91⅛	8.8⅜	..
1,848,772	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %	107 —109	107 —109	108⅜	107⅛	..
800,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	13⅜ — 14½ xd	13⅜ — 14½	14⅛	13⅜	..
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	105½—107½	105½—107½	106½	..	..
800,000	East & S. Afric. Tel., 4 % Mt. Db., 1 to 8,000, red. 1909	100	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..
200,000	Do. 4 % Reg. M. Debs. (Mauritius Ext.) 1 to 8,000	25	4 %	4 %	4 %	4 %	101 —103	101 —103	102	..	..
180,887	Globe Telegraph and Trust	10	£3	5½%	5½%	5½%	10⅜— 11⅛	10⅞— 11⅛	11⅛	10⅞	..
180,887	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	14⅜— 14⅝	14⅜— 14⅝	14⅝	..	..
150,000	Great Northern Telegraph, of Copenhagen ..	10	12½%	15 %	24 %	24%	34 — 36	34 — 36	..	..	..
97,900	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	100½—102½	100½—102½	..	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	13 %	13 %	59 — 61	59 — 61	..	..	..
251,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	1 — 1¼	1 — 1¼	20/6	20/3	..
72,680	Monte Video Telephone Co., Ltd. Ord.	1	8 %	8 %	4 %	5 %	1⅛ — 1⅛	1⅛ — 1⅛	..	..	+1/32
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	5 %	⅞ — 1	⅞ — 1	..	..	..
1,983,333	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	109 —111	108 —110	110¼	108½	—1
1,966,667	Do. do. Def. Stock	100	4½%	5 %	5 %	5 %	109 —111	106 —108	110½	106½	— 3
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	11 — 13	11 — 13	..	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10¾— 12½	10¾— 12½	..	..	..
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅜— 5⅝	5⅜— 5⅝	5½	5 7/16	— ⅛
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	98 —100	98 —100	99⅝	..	..
1,689,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	102 —104	100½—102½	103½	101½	—1½
179,313	Oriental Telep. and Elec. 1 to 171,504, fully pa..	1	6 %	6½%	6½%	7½%	1 5/16 — 1 7/16	1 5/16 — 1 7/16	26/3	..	..
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1 5/16 — 1 7/16	1 5/16 — 1 7/16	..	..	..
100,000	Do. do. do. 4% Red. Deb. Stock	100	..	..	..	4 %	97 — 99	97 — 99	..	..	..
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	99 —102	99 —102	100	..	..
11,889	Reuter's	8	5 %	5 %	5 %	5 %	7½ — 7⅞ xd	7½ — 7⅞xd	7½	..	..
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	..	4½%	101 —104	101 —104	..	..	..
3,201	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	129 —132	127 —130 xd	127	..	— 2
70,000	United River Plate Telephone	5	7 %	8 %	8 %	8 %	7 — 7⅝	7 — 7⅝	7 7/32	..	..
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5¼ — 5⅜	5¼ — 5⅜	..	..	..
172,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	5 %	109 —112	109 —112	..	..	..
15,609	West African Telegraph, Shares	10	2 %	4 %	4½%	4 %	9⅜— 10¼	9⅜— 10¼	..	..	..
30,000	W. Coast of America, 1 to 30,000 & 53,001 to 58,000	2½	Nil	Nil	Nil	Nil	⅜ — ½	7/16 — ½	..	..	— 1/16
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	100½—103½	100½—103½	..	..	..
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980 ..	10	7 %	7 %	7 %	7 %	14⅜— 14⅝	14 — 14½	..	..	— ⅛
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	5 %	5 %	5 %	.. — ..	.. — ..	..	..	..
568,880	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	103 —106	102 —105	103	..	—1
88,821	West India and Panama Telegraph	10	Nil	Nil	Nil	..	⅜ — ½	⅜ — ½	..	..	..
34,568	Do. do. 6 % Cum. 1st Pref.	10	7 %*	7 %*	6 %	5 %	6⅝ — 7¼	7 — 7¼	7	..	+ ⅛
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	Nil	4¼ — 5½	4½ — 5½	..	..	..
80,000	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	99 —102	99 —102	..	..	..

Including arrears.

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

270,000	Anglo-Argentine Trams, Nos. 460,000 to 510,007, and 560,008 to 580,007	5	..	..	8 %	8 %	7 1/16 — 7 1/8	7 — 7¼	7 3/32	7 1/16	— 1/16
260,007	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	..	5 %	5 %	5½%	5⅛— 6 1/16	5⅛— 6 1/16	5⅜	..	..
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	..	6 %	6 %	6 %	139 —142	139 —142	140½	..	..
285,100	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	..	5 %	5 %	5 %	103 —105	103 —105	..	..	..
800,000	Babcock & Wilcox, 1 to 580,000	1	..	17 %	20 %	20 %	3¼ — 4¼	3⅜ — 4	81/3	77/6	— ⅛
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	..	6 %	6 %	6 %	1 1/16 — 1 1/8	1 1/16 — 1 1/8	..	..	..
88,000	British Aluminium, Ord., 2,001 to 40,000	5	..	..	7 %	7 %	5⅜ — 5⅝	5 11/16 — 5 13/16	5⅝	..	+ 1/16
40,000	Do. do. 7 % Cum. Pref...	5	Nil	Nil	7 %	7 %	6½ — 7	6½ — 7	6 23/32	6⅝	..
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	6 %	6 %	5¼ — 5⅜	5¼ — 5⅜	..	..	..
20,000	Do. do. 4 % Funding Certs.	5	..	..	4 %	4 %	4 — 4½	4 — 4½	..	..	..
800,000	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	104 —108	104 —108	100⅔	..	..
800,000	British Columbia E. Rail Def. Ord. Stock	100	..	6 %	6 %	6 %	122 —125	125 —130	127½	..	+ 4
800,000	Do. 5 % Pref. Ord. Stock	100	..	5 %	5 %	5 %	110 —115	110 —115	..	..	..
115,000	Do. 5 % Cum. Perp. Pref. Stock	100	..	5 %	5 %	5 %	108 —111	108 —111	110	..	..
240,400	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	..	4½%	4½%	4½%	102 —104 xd	102 —105 xd	104½	..	..
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	..	4½%	4½%	4½%	103 —106	103 —106	..	..	— ½
183,301	British Electric Traction	10	8 %	6 %	6 %	3 %	4 — 5	3⅝ — 4⅜	90/-	85/-	..
161,487	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %	8 — 9	7⅞ — 8½	8 5/16	7⅞	— ½
1,415,422	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	107 —111	107 —111	109½	109	..
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	..	4½%	4½%	92½— 95½	90 — 93	91	..	—2½
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	8 %	6½ — 6⅝	6½ — 6⅝	..	..	..
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅞ — 6⅛	5⅞ — 6⅛	..	..	..
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	102 —105	102 —105	102	..	..
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	..	4½%	4½%	4½%	94 — 98	94 — 98	..	..	..
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	..	6 %	Nil	..	1 — 1⅛	1⅛ — 1⅜	..	..	+ ⅛
1,016,358	Do. do. 4 % Mort. Deb. Stock ..	100	..	4 %	4 %	4 %	77 — 80	77 — 80	77⅜	77	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	13/6 — 14/6	13/6 — 14/6	..	..	..
50,000	¶ Do. do. 6 % Cum. Pref. ..	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..
105,781	Brush Electrical Engineering, Ord., 1 to 105,781 ..	2	Nil	Nil	Nil	2½%	½ — 1	½ — 1	18/1½	16/3	..
150,000	Do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	6 %	1¼ — 1⅜	1¼ — 1⅜	25/-	..	..
125,000	Do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	96 — 98	96 — 98	..	..	..
125,000	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	82 — 84	82 — 84	..	..	..
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	..	3 %	4 %	3 %	3 — 3½	3 — 3½	..	..	..
40,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	..	6 %	6 %	6 %	5½ — 5⅝	5½ — 5⅝	..	..	..
27,500	Do "B" do. 1 to 27,500	5	..	6 %	6 %	6 %	4⅝ — 5⅛	4⅝ — 5⅛	..	..	..
317,700	Do. 5 % Deb. Stock	100	..	5 %	5 %	5 %	105 —107	105 —107	..	..	..
190,000	Do. 5 % 2nd Deb. Stock	100	..	5 %	5 %	5 %	102 —105	102 —105	..	..	..
105,000	Calcutta Trams., 1 to 105,000	5	..	8 %	8 %	8 %	8 — 8½	8 — 8½	8	7⅝	..
82,610	Do. 105,001 to 187,610	5	..	..	..	8 %	7⅞ — 8⅛	7⅞ — 8⅛	..	..	..
29,330	Do. 5 % Cum. Pref., Nos. 1 to 29,330	..	..	..	..	..	5½ — 5⅝	5½ — 5⅝	5 11/16	5⅝	..
350,000	Do. 4½ % 1st Deb. Stock	100	..	4½%	4½%	4½%	103 —106	103 —106	..	..	..
85,000	Callender's Cable Construction shares	5	15 %	12½%	12½%	15%	10½— 11½	10½— 11½	10⅜	..	..
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅜— 5¾	5⅜— 5¾	5 11/16	..	..
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	108 —110	108 —110	109½	..	..
491,222	Cape E. Trams., 1 to 491,222	1	..	15 %	10 %	5 %	⅜ — ⅝	⅜ — ⅝	10/9	..	..
450,000	Castner-Kellner Alkali, 1 to 450,000	1	..	4 %	4 %	6 %	1 3/16 — 1 5/16	1 3/16 — 1 5/16	21/10½	21/3	..
230,211	Do. do. 4½ % 1st Mort. Deb. Stock	100	..	4½%	4½%	4½%	97 —102	97 —102	100⅜	..	..
1,999,698	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	83 — 85	83 — 85	84½	83½	..
530,316	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	97 — 99	97 — 99	99	..	..
530,316	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	73 — 76	73 — 76	73	..	..
1,480,000	City and South London Railway	Stock	3½%	3½%	3½%	3½%	43 — 45	42 — 44	44	42½	..
85,000	Crompton & Co., Nos. 1 to 85,000	8	5 %	2½%	2½%	2½%	1½ — 1⅝	1½ — 1⅝	..	..	..
100,000	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	95 — 98	95 — 98	..	..	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § Interim dividends.
‖ And bonus of 10s. ¶ From Manchester Share List.

(Continued on next page.)

SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued.)*

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—*(continued).*

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1902.	1903.	1904.	1905.	Closing Quotations Oct. 16th.	Closing Quotations Oct. 23rd.	Business done week ended Oct. 23rd, 1906. Highest	Lowest.	Rise + or Fall—
		†									
260,000	Dick, Kerr & Co., 1 to 260,000	1	..	..	10 %	..	1¼ — 1⅜ xd	1 7/16 — 1 9/16 xd	..	..	..
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	..	6 %	6 %	6 %	1 5/16 — 1⅜	1⅜ — 1½	23/9	..	..
294,150	Do. do. 4½ % Deb. Stock	100	..	4½ %	4½ %	4½ %	103 —106	103 —106	..	..	..
60,000	Dublin United Trams. (1896), 1 to 60,000	10	..	5½ %	6 %	6 %	14 — 15	14 — 15	..	..	..
59,987	Do. 6% Pref. between 1 and 60,000	10	..	6 %	6 %	6 %	14 — 15	14 — 15	..	..	..
99,261	Edison & Swan Utd., "A" shrs., £8 pd., 1 to 99,261	5	Nil	Nil	2½ %	4⅓ %	1½ — 1⅝ xd	1½ — 1⅝ xd	..	..	..
17,139	Do. "A" shares, 01—017,139	5	Nil	Nil	2½ %	4⅓ %	2⅛ — 2¼ xd	2⅛ — 2¼ xd	..	..	..
844,023‡	Do. "A" shares, 01—017,139	5	Nil	Nil	2½ %	4⅓ %	2⅛ — 2¼ xd	2⅛ — 2¼ xd	..	..	..
100,000‡	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	86 — 88	£6 — 88	..	..	..
112,100	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	90 — 95	90 — 95	..	..	..
112,100	Electric Construction 1 to 112,100	2	6 %	4 %	Nil	Nil	1/16 — 1/8	1/16 — 1/8	5/-	..	— 1/16
31,890	Do. do. 7 % Cum. Pref., 1 to 31,890	2	7 %	7 %	7 %	7 %	1⅞ — 2⅛	1⅞ — 2⅛	36/3	..	..
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Stk.	Stock	4 %	4 %	4 %	4 %	83 — 86	83 — 86	..	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	5 %	9 — 9¼	9 — 9¼	..	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	91 — 94	91 — 94	..	..	..
78,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	10	..	3 %	4 %	4 %	3½ — 3⅝	3⅝ — 4	71/3	..	+ ⅛
96,000	Greenwood & Batley 7 % Cum. Pref.	10	..	7 %	7 %	7 %	10½ — 10¾	10½ — 10¾	..	..	..
80,000	Do. do. 5 % Mort. Debs.	100	..	5 %	5 %	5 %	101 —102	101 —102	..	..	..
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	20 %	15 %	15 %	15%	12 — 13	12 — 13	..	..	..
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..
150,000	Do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	107⅛—102⅝	107⅛—109⅛	108⅞	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works..	10	10 %	10%	5 %	10%	17 — 18	17 — 18	17⅞	17½	..
37,500	†Liverpool Overhead Railway, Ord.	10	14%	18%	12½ %	Nil	1 1/16 — 1 1/8	1 1/16 — 1 1/8	..	..	..
10,000	† Do. do. Pref. £10 paid	10	5 %	5 %	5 %	6 %	4¼ — 6¼	4¼ — 6¼	..	..	..
600,070	London United Trams (1901), 1 to 50,007	10	..	8 %	6 %	8 %	8 — 8½	8 — 8½	..	..	..
899,980	Do. do. 50,008 to 100,000 (£6 paid)	10	..	8 %	6 %	8 %	8¾ — 9	9⅛ — 9⅜	..	..	..
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	..	5 %	5 %	5 %	9 — 9¼	8⅞ — 9¼	9 5/16	9 1/16	— ⅛
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	93 — 96	90 — 95	92¼	..	—2
314,016	Metropolitan Electric Trams, Defd.	1	Nil	Nil	Nil	3 %	1/16 — 1/8	1/16 — 1/8	2/-	..	— 1/32
500,000	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	1/16 — 1/8	1/16 — 1/8	17/3	16/6	..
350,000	Do. 4½ % Deb. Stock Red.	100	..	..	4½%	4½%	95 —100	95 —100	98½	..	..
150,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 50,000	5	..	..	6 %	6 %	4⅜ — 5	4⅜ — 5	92/6	..	..
24,500	Potteries E. Trc., 20,001 to 40,000 & 50,001 to 54,500	10	..	5 %	5 %	4 %	6¼ — 7¼	6¼ — 7¼	..	..	..
24,500	Do. 5 % Cum. Pref., 1 to 20,000 & 40,001 to 44,500	10	..	5 %	5 %	5 %	7¼ — 8¼	7¼ — 8¼	..	..	..
245,000	Do. 4½ % Deb. Stock	100	..	..	4½%	4½%	100 —103	101 —104	..	..	+1
97,350	Telegraph Construction and Maintenance	12	20 %	20 %	15 %	15 %	32½ — 34½	32½ — 34½	..	..	..
150,000‡	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..
8,599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	..	5 %	5 %	90 — 92	90 — 92	..	..	..
540,000	Waterloo & City Railway, Ord. Stock	100	3½%	3½%	3½%	3½%	101 —104	99 —102	100	..	—2
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	3⅓%	3 %	Nil	Nil	⅞ — 1	⅞ — 1	..	..	..
66,666	Do. 6 % C. P., 30,001 to 80,000 & 125,001 to 141,666	5	..	6 %	Nil	Nil	1½ — 2¼	1½ — 2¼	..	..	..
246,806	Do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	75 — 80	75 — 80	..	..	..

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P., 1 to 14,000	5	..	5 %	5⅓%	4 %⅓	5 — 5⅓	5 — 5⅓	..	..	..
50,000	Do. do. 4½ % 1st. deb. stock	100	..	4½%	4½%	4½%	101 —104	101 —104	102½	..	..
29,877	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	8 %	10 %	10 %	10 %	8⅜ — 8⅝	8⅜ — 8⅝	..	..	..
10,623	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7⅝ — 8	7⅝ — 8	..	..	..
300,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	101 —104	101 —104	..	..	..
80,000	Charing Cross and Strand Electricity Supply	5	10 %	8 %	8 %	5 %	3½ — 4¼	3¼ — 4¼	70/-	..	..
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4⅜ — 5	4⅜ — 5	..	..	..
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	4 — 4½	4 — 4½	..	..	..
420,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	101 —104	101 —104	102	..	..
44,436	Chelsea Electricity Supply, Ord.	5	4½%	5½%	6 %	6 %	5½ — 5⅝	5 — 5⅛	..	..	— ¼
175,000‡	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	106 —109	106 —109	..	..	..
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	5 %	6 %	6 %	9½ — 10½	9½ — 10½	10½	10	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	11⅝ — 12½	11 — 12	..	..	— ½
400,000‡	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	123 —126	123 —126	..	..	..
800,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	100 —103	100 —103	102½	101	..
40,000	County of Durham Electrical Power, Ord.	2	4 %	4 %	£3 7 0	4 %	2 1/16 — 3 3/16	2 1/16 — 3 3/16	..	..	..
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4½%	5 %	8½ — 8⅞	8¼ — 8⅝	..	..	..
30,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	11⅝ — 12	11⅝ — 12	..	..	..
400,000‡	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	107 —110	107 —110	..	..	..
400,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	7 %	4 %	3½ — 3⅝	3 — 3¼	67/6	65/-	— ½
80,000	Do. do. 6 % Cum. Pref.	..	6 %	6 %	6 %	6 %	4⅜ — 5⅛	4⅜ — 5⅛	5 1/16	..	..
320,000	Do. do. 4½ % 1st Mort Deb. Stk	100	4½%	4½%	4½%	4½%	100 —103	100 —103	101½	..	..
10,000	Folkestone, 1 to 10,000	5	..	5½%	5½%	5½%	5⅛ — 5⅝	5⅛ — 5⅝	..	..	..
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	..	5 %	4⅛ — 5⅜	4⅛ — 5⅜	..	..	..
75,000	Do. 4½ % 1st. Deb. Stock	100	..	4½%	4½%	4½%	99 —102	99 —102	..	..	..
18,000	Hove, 1 to 18,000	5	..	8½%	8½%	9 %	8 — 8⅛ xd	8 — 8⅛	..	..	..
10,000	Do. New (£6 10s. paid)	£3	..	8½%	8½%	9 %	6⅔ — 7⅓	6⅔ — 7⅓	..	..	..
97,300	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	98 —101	98 —101	..	..	..
7,300	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	98 —101	98 —101	..	..	..
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	12½ %	12 %	10 %	9⅞ — 10⅛	9⅞ — 10⅛	..	..	..
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	99 —102	99 —102	99½	..	..
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	Nil	3 %	4 %	1⅜ — 2⅛	1⅜ — 2⅛	..	..	..
60,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	5 — 5⅜	5 — 5⅜	..	..	..
874,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	96 — 99	96 — 99	98½	..	..
200,000	Metropolitan Electric Supply, 1 to 100,000	5	7½%	8½%	10 %	10 %	7⅛ — 8⅛	7⅛ — 8⅛	8	..	..
76,121	Do. 4½ % Cum. Pref. 1—71,106, £3 pd.	5	4½%	4½%	4½%	4½%	5⅜ — 5⅝	5⅜ — 5⅝	5⅝	5 7/32	..
230,000‡	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	109 —113	109 —113	..	..	..
250,000‡	Do. 5% Mort. Deben. Stock Redeem.	Stock	5½%	5½%	5½%	5½%	95 — 97	95 — 97	..	..	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..
75,000	Newcastle-on-Tyne, 1 to 75,000	5	..	8 %	8 %	8 %	7⅝ — 8	7⅝ — 8	..	..	..
75,000	Do. 5 % Pref., 1 to 75,000	5	..	5%	5 %	5 %	5⅝ — 6⅛	5⅝ — 6⅛	..	..	..
10,852	Notting Hill Electric Lighting	10	6 %	6 %	7 %	7½%	13½ — 14½	13½ — 14½	13½	..	..
64,000	Do. do. 4 % 1st Mort.Deb.	100	4 %	4 %	4 %	4 %	96 — 98	96 — 98	..	..	..
18,500	Oxford, 1 to 96 and 407 to 18,810	5	..	6½%	7 %	7 %	6 — 6½	6 — 6½	..	..	..
50,000	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	98 —100	98 —100	..	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	12½%	9½ — 10½	9½ — 10½	..	..	..
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	7 — 8	7 — 8	..	..	..
150,000‡	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	3½%	95 — 97	95 — 97	..	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	2½%	4 %	4 %	4 %	1 — 2	1 — 2	..	..	..
80,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	74 — 78	74 — 78	..	..	..
65,000	South London Electricity Supply, Ord.	5	12½%	8 %	4 %	4 %	2⅜ — 3½	2⅜ — 3½	..	..	..
103,700	South Met. Elec. Lt. & Power (Ord.	1	Nil	Nil	Nil	2½%	3/32 — 1/16	3/32 — 1/16	..	..	..
85,368	*(Late Blackheath and Greenwich* 7 % Pref.	1	Nil	7 %	7 %	7 %	1 5/16 — 1 1/16	1 5/16 — 1 1/16	25/3	..	..
148,292	*Dist. E.L.Co.)* 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..
50,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	3⅛ — 3⅜	3⅛ — 3⅜	..	..	..
80,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	4⅛ — 4½	4⅛ — 4½	..	..	..
90,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	100	..	..	4½%	4½%	97 —100	97 —100	98½	..	..
110,000	Westminster Electric Supply, Ord.	5	12 %	12½%	14 %	12 %	9 — 10	9 — 10	9⅝	9⅛	..
88,161	Do do. 4½ % Cum. Pref. (Originally 5 %—Red. to 4½ % from 31st Dec., 1905.	5	5 %	5 %	5 %	5 %	5⅛ — 5⅜	5⅛ — 5⅜	5⅜	..	..

Shares not officially quoted:—Mackay Companies, ord., 73—75. Pref. 72—74.

† Unless otherwise stated all shares are fully paid. ‡ Interim dividends.

(Bank rate of discount 6 per cent. October 19th. 1

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING SEPTEMBER, 1906.

That the returns of electrical export and import business during September show a considerable falling-off compared with preceding months, will be apparent from a perusal of our tabulated returns. Not only is this so, but the exports, valued at £104,327, are the lowest we have had to record during 1906, and compare with £124,031 in the month of August, and £127,000, the average of the eight preceding months.

The imports, also much reduced in value, stand at £139,309—a figure some £23,000 less than in August, and less than the past eight months' average of £145,000. It may be noted, however, that these values are better than were recorded in the corresponding months of 1905.

The re-exports, although of comparatively small value, continue the upward tendency which we have noted during the year. From £12,733 in August they have jumped to £18,677 in the month under review, the latter figure being much the highest recorded by us in connection with these returns, and £10,000 in excess of the total of September, 1905.

The majority of the individual classes of material are, of course, more or less reduced in value compared with last month, exceptions being in the exports of fittings, telephonic material and carbons, and in the imports of electrical cable, lamps, carbons, &c.

It is satisfactory to note that, despite the general reduction in business, our exports of electrical and electrically-driven machinery were as well maintained as in previous months.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.

Country receiving exports and importing.	Electrical goods and appliances.	Electrical cable.	Electric lighting fittings and accessories.	Electric lamps.	Electric meters and instruments.	Electric machinery.	Batteries and accumulators.	Carbons.	Telegraph and telephone material, and electric bells.	Electrically-driven machinery.	Tramways apparatus and materials.
	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark	750	104	36	152	6	657	...	...	16	...	...
Germany	369	26	30	...	...	124	36	15	...	...	...
Netherlands	4	288	226	4	...	45	...	...	...	...	...
Java and Dutch Borneo	7	...	3	...	...	...	...	...	...	...	...
Belgium	131	26	121	2	55	86	2	...	90	...	...
France	119	2	76	15	35	27	255	...	...	...	...
Portugal, Madeira and Portuguese Africa ...	208	5	129	15	97	506	231	...	51	61	...
Spain and Canary Isles	62	44	43	40	...	202	5	...	28	...	...
Italy and Austria-Hungary	235	...	25	415	821	2,007	...	20	...	10	...
Greece and Turkey	...	...	...	...	...	390	...	...	22	...	...
Egypt and Tunis	357	37	152	...	...	382	31	258	96	219	...
China and Siam	398	457	832	149	516	520	25	...	134	...	...
Japan	165	5,804	493	112	1,112	8,406	...	13	720	...	...
U.S.A., Philippines, Cuba and Hayti	322	...	...	...	45	324	15	...	...	...	...
Mexico and Colombia	9	11	...	...	...	449	...	...	...	...	...
Peru and Uruguay	21	132	...	...	...	8	13	...	6	...	...
Chili	30	451	115	52	...	568	7	...	47	...	...
Brazil	83	364	244	149	12	711	...	...	30	379	...
Argentine	843	2,732	1,004	...	...	2,515	247	...	197	21	...
Channel Isles, Gibraltar and Malta	259	685	233	8	32	112	9	...	...	2,595	...
British West Africa	100	36	...	5	16	26	10	...	...	...	...
Cape of Good Hope	867	1,665	585	166	34	6,642	32	...	70	165	...
Natal	397	365	1,908	242	215	1,678	146	3	363	327	...
Zanzibar, Brit. East Africa, Mauritius and Aden	102	11	3	...	5	4	...	1	235	20	...
India	1,701	3,347	1,345	507	445	5,448	163	43	509	1,476	382
Burmah	30	252	672	...	...	1,507	...	...	...	13	...
Ceylon	54	37	85	6	104	110	...	...	13	195	...
Straits Settlements, and Fed. Malay States ...	416	1,908	992	28	103	204	8	20	48	...	...
Hong Kong	19	28	74	8	...	240	...	...	...	...	...
West Australia	66	49	137	45	296	602	13	...	...	...	...
South Australia	27	...	180	10	11	58	...	...	...	...	...
Victoria	572	1,301	9	7	94	974	219	26	6	5	...
New South Wales	1,002	1,336	190	1,066	55	653	57	24	30	8	...
Queensland	63	45	36	14	2	200	...	7	6	...	...
Tasmania	...	...	12	...	...	85	30	...	...	...	...
New Zealand	662	2,710	685	97	85	1,131	49	...	440	59	...
Canada	237	...	564	...	24	154	1,436	10	21	...	...
British West Indies and British Guiana ...	7	13	38	...	...	210	8	...	4	...	...
Total, £	10,692	24,265	11,277	3,314	4,420	37,865	3,047	440	3,182	5,553	382

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

	£	£	£	£	£	£	£	£	£	£	£
Norway, Sweden and Denmark	27	206	8	95	...	1,218	88	7	9,238	15	...
Holland	618	5,493	1,216	6,086	5	1,292	551	3,520	631	...	...
Germany	475	15,859	610	1,627	37	8,243	1,019	279	3,000	...	...
Belgium	321	2,069	515	3,961	385	5,744	160	931	16,039	...	...
France	532	5,307	289	2,389	829	3,153	111	6,099	...	...	...
United States	1,809	1,320	752	634	104	22,986	133	81	...	1,140	...
Italy	...	53	...	...	...	...	...	...	...	...	...
Total, £	3,782	30,307	3,390	14,792	1,360	42,636	2,062	10,917	28,908	1,155	...

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

	£	£	£	£	£	£	£	£	£	£	
Various countries, mainly as above	2,661	7,348	645	37	...	144	224	158	7,460	...	...

Total Exports: £104,327

Total Re-Exports: £18,677

Total Imports: £139,309

Note.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns.

REVIEWS.

Notes on Electro-Chemistry. By F. G. Weichmann, Ph.D. New York: The McGraw Publishing Co. 1906. Price $2.00.

One's first impulse on opening this little book is to throw it aside; the type, paper, ink and printing are so poor that it is scarcely possible to open it anywhere without the eye lighting on broken serifs, stuffed a's, e's, s's, &c., and thin, almost inkless, letters of all sorts. Verily the mercies of mechanical composition are punishments we have not deserved, and gladly would we pay blackmail to be delivered from them. Let them proudly flourish in the half-penny press, but preserve us from their gambollings in books.

We make the above remarks feelingly, for on conquering our disgust and setting to work to read the book, we were agreeably surprised to find it very well worth the trouble. To begin with, the treatment is original. One does not expect a treatise of this kind to start at the very beginning with the fundamentals of all science; yet that is what our author does. He devotes nearly two pages to an explanation of what science is; how laws are assumed by induction from experiment, or, being assumed as hypotheses, are verified or rejected according to their power of explaining phenomena. Thence he proceeds to show that the ultimate test of the validity of a law is the power of predicting unknown phenomena, and so on. Next follow definitions of matter and energy, and two more pages of an explanation of the C.G.S. system of electrical measurement, and then in Chapter II we get to work on theories of electricity, factors of electrical energy, and properties of electricity.

It is here that the peculiarity of the book is best seen, for no description of the phenomena has a yet been attempted, while when, on page 15, we get to this, a number of effects are described as arising from the action of "a plate of copper and a plate of zinc placed in a vessel containing dilute sulphuric acid," which could be by no means produced by such simple apparatus, and then we realise with astonishment that some pages back, at pages 11-13, we have gone through a very well condensed description of the electrical explanation of radio-activity. Here it suddenly strikes us that the copper and zinc plates are used as a conventional expression for an electrical apparatus of considerable power, and that the book must be intended for those having a good practical knowledge and a considerable theoretical grounding in electricity.

For such persons the book is undoubtedly useful, and now we, perhaps, arrive at a comprehension of the peculiar way in which it handles its subject. It is the result of the existence in the United States of that particular versatility which leads men perpetually to change their occupation, and the demand for such works arises from the existence of vast numbers of practical "Electricians" who have had little scientific training. The book, in fact, begins in an endeavour to teach the man with a pair of cutting pliers and a coil of wire something of the mystery with which he is daily dealing.

Having beguiled him to go so far, our author proceeds to do his best to compel him to "drink deep of the Pieirian spring" for, by chapter IV, we are landed in the very difficult matter of electrolytic dissociation, and the work of Van't Hoff, Arrhenius, J. J. Thomson, Ostwald, and Nernst.

Were we not dealing with a book essentially intended to be read from an electrical standpoint, we should here object somewhat strongly to the way in which the real meaning of the phenomena is completely overlooked in a study of the electrical means used to measure them.

In plain English, the facts are the dissociation of solutes by solvents due to mutual strain or stress, *i.e.*, the endeavour of the constituents of the solvent and the solute to rearrange themselves by means of a release or degradation of energy. This causes dissociation, and dissociation can be easily measured electrically. We fail to see that this justifies the ascription of dissociation to electrical action.

However, we must not blame Dr. Weichmann for this, for if, as we think, he sins, he does it with high authority, and he may urge that he is not dealing with his subject philosophically, but as a practical electrician.

"Electrolytic Dissociation," the subject of Chapter IV, is very thoroughly dealt with in 25 pages, followed by 27 pages on "Electro-Analysis," Chapter V, and 46 pages on "Electro-Technology," Chapter VI.

The last is, of course, the criterion from the practical man's standpoint, and it is possible that he will feel that the subject is too big for the space allotted. This is certainly the case with electro-plating—a subject we have never yet seen adequately dealt with—and the electrical production of alkalies and of metals is compressed to very small dimensions.

Nitrogen oxidation, which has caused some talk of late, is very shortly dismissed, and the author seems not to be aware of what has recently been done in Sweden, as he refers only to the small experimental plant at Niagara Falls.

But, after all, these defects are small, and it is to be hoped that they will have the effect of stimulating readers to search for further knowledge. The author certainly gives every opportunity for this, for each chapter is headed with a bibliography, and Chapter VI, in addition, has numerous footnote references to books and papers on the subjects dealt with.

On the whole, we attach most value to the third, fourth and fifth chapters, which contain a mass of information that cannot fail to be of great use to all engaged in either the study or the practice of electrotechnics.

It will be noticed that the book confines itself within somewhat narrow limits; the chemistry of the cell is but briefly dealt with, and that very important subject, the storage battery, is not mentioned, though its possibility is hinted at in the very brief remarks headed "Reversible Reactions and Cells" on pp. 69-70. Again, nothing is said of Bredig's work on the production of colloidal metals, or of Kuzel's experiments on the manufacture of lamp filaments from electrically-produced metallic colloids, subjects likely to have important developments in economising energy in electric lighting.

The subject is, however, so vast that something must be left out if a book is to be kept within reasonable limits as to size and cost, and our author no doubt felt that wherever he drew the line something of importance would be excluded. We hope that if a new edition is called for he will take some of these into his subject matter, and that, though it does not strictly come within his boundaries, he may add a few notes on the cost of electrical energy under varying conditions. To the publishers we would suggest a better, more durable, and less loaded paper, and above all things, a very much better fount of a true book type.

Règles Normales de l'Association des Electriciens Allemands. By Dr. G. Dettmar. Translated by F. Loppe and A. Thouvenot. Paris: H. Dunod and E. Pinat. Price 2.50 fr.

These *Règles Normales* are an attempt to standardise electrical practice regarding definitions, testing, and comparison of machines and transformers. They consist of some 48 articles, each laying down with dictionary-like precision, a definition, or the course to be followed during a test. Among the subjects dealt with are rating of power, elevation of temperature, overload, insulation, efficiency and methods for its determination, and variation of pressure.

The greater part of the interest of this little book lies in the commentary on the rules, given in the appendix by the author. After remarking on the benefits likely to accrue to the industry from standardisation, he says that the foregoing rules in their rough form were submitted to manufacturers and persons of eminence in the profession, that 23 sets were returned with comments, and that the present set of rules were then drawn up and established.

It is notorious that there is no set system of definitions employed by the trade, and especially is this true of alternating-current work. The author waxes very virulent on this head. For example, in polyphase machines it has been decided to call the pressure measured between the neutral point and each of the conductors "star pressure," and that between any two conductors "phase pressure." Again, instead of our old friends "stator" and "rotor, we are to have "primary armature" and "secondary armature."

Under the heading "Power," a sharp distinction is drawn between machines for (1) intermittent; (2) momentary; (3) continuous working. The elevation of temperature for (1) is to be taken after one hour's uninterrupted running;

for (2) after a time more or less arbitrary; for (3) after 10 hours' uninterrupted running for machines, and for transformers after sufficient time to allow the temperature to become stationary.

Article 12 states that for machines under test, a reproduction should be made, as far as possible, of the ventilating conditions of actual practice.

As is well known, very large machines will not attain a stationary temperature even after 10 hours' running, and the author explains that the figure 10 was decided on because it would include the generality of cases. It seems absurd and very uneconomical to run a small generator for 10 hours to get the test temperature, but after consideration of three durations of time for small, intermediate and large machines respectively, we are told, the difficulties became insurmountable, and the 10-hour limit was taken for all. What would some of our testing departments say to running their 3-horse motors for 10 hours!

Art. 13 says that the atmospheric temperature must be taken at a distance and height of 1 metre from the machine under test. This is good, inasmuch as it gives a standard for allowing for the effects of radiation.

The temperatures of all windings must be taken by the resistance method, so as to obtain a mean reading.

Art. 22 states that overload trials must always be made at normal temperatures, that generators, &c., must withstand a 25 per cent. overload for half an hour, and motors and transformers 40 per cent. for 3 minutes.

As regards insulation, we are told that machines and transformers should be able to support for half an hour, and while they are hot, a fixed pressure somewhat higher than the working pressure. Contrary to custom, there are no absolute laws laid down, as it has been found impossible to provide for everything.

Altogether, it is a very suggestive and instructive little book.

Paraguay in Wort und Bild. By R. v. Fischer Treuenfeld. Berlin: Ernst Siegfried Mittler und Sohn. Price M. 5.

This volume, which is a study of the industrial progress of the Republic of Paraguay, is written by the Consul-General of that country in Saxony, and may consequently be taken to be an accurate and authoritative statement of its present condition. The author has evidently made a careful study of the past history, the present condition and the future prospects of Paraguay, with the result that we have before us a carefully-written and exhaustive volume dealing with the country from almost every standpoint. The author certainly speaks in very glowing terms of the prospects of the country, but he gives ample proofs, statistically and otherwise, of his statements.

He sets out with the statement that the world's industry and trade constantly require new markets, that new countries require settlers, and that settlers require countries which will yield a good return for their labours. Making this statement his basis, the author, directly or indirectly, devotes the remainder of the volume to proving that Paraguay is a new market which will give ample opportunities for trade extension, that it is greatly in need of foreign settlers and foreign capital, and that it offers the very best prospects to both. The volume deals with the geographical and climatological condition of the country, its mineral, vegetable and animal wealth, its history, government, population, agriculture, industry, finances, means of communication, prices of land, labour and food, &c.

The wonderful revival of trade since the war of 1870, before which Paraguay was one of the leading countries of South America, and during which she lost 600,000 men out of a total of 800,000 before the war, would, in itself, be sufficient proof that the country possesses vast natural resources capable of being speedily realised. These resources are not by any means exhausted; in fact, the exploitation of them may be said to be only in its infancy, and for their further exploitation the country is urgently in need of foreign capital and labour. That Paraguay is a country of great possibilities is further proved by the fact that foreign capitalists are flocking to the Republic, that railways and telegraph lines are being rapidly extended, that banks and commercial undertakings are being founded, and that oversea trade is greatly on the increase. The crying need of the country is for a better system of communication by road, river, railway and telegraph, and with the advent of improvements in this direction, there can be no reasonable doubt but that Paraguay is capable of as great a commercial development as has been witnessed in Argentina during the past few years. From our own point of view we could have wished that the author had told us more as to the possibilities of electrical development in Paraguay, but the fact that there is practically no mention of any electrical undertakings in the country is, perhaps, sufficient proof that there are great possibilities in this direction. Few markets offer such opportunities for the electrical industry as do the South American States, as a whole, and we cannot think that Paraguay is any exception to the rule.

The book is extremely well written, and in parts (notably the chapter on the history of Paraguay) forms very interesting reading, apart from its commercial value. It is beautifully illustrated and contains two maps, one of Paraguay and one of South America as a whole; we can well recommend it to all merchants and manufacturers interested in trade with Paraguay, and could wish that other writers of the author's standing would favour us with books of a similar character dealing with the other South American States about which so little collected information, of a commercial nature, has been published.

THE MILAN TRAMWAYS CONVENTION.

At this recent Convention M. Scholtes reported on brakes, and considered that the opinion expressed by last year's committee in favour of the electric brake for service had been confirmed by the further replies returned this year. M. L. Petit was put up to say the best he could for the air brake as a known partisan of that system, and, naturally enough, he came to a conclusion exactly opposite to that of M. Scholtes. No; they agreed that the air brake is indispensable when the cars are very heavy and run at high speeds, or when trail cars are used, and the general opinion in England is with them.

The following table, given by M. Scholtes, is compiled from the replies of 142 companies, and gives in compact form a good idea of Continental practice:—

Continental Practice in Tramcar Brakes.

System of braking.	Number and weights of cars. All weights are given in metric tons.									Number of cars.		Number of companies.	
—	From 5 to 6 tons.	From 6 to 7 tons.	From 7 to 8 tons.	From 8 to 9 tons.	From 9 to 10 tons.	From 10 to 11 tons.	From 11 to 12 tons.	From 12 to 13 tons.	From 13 to 16 tons.	Total.	In per cent.	Total.	In per cent.
Hand brakes ...	238	508	1,639	1,335	1,095	14	22	154	7	5,012	34·4	71	50·0
Electric... ...	16	436	924	2,232	3,086	100	204	234	34	7,266	50·0	60	42·2
Air brakes ...	0	21	286	426	216	326	71	704	235	2,285	15·6	11	7·8
										14,563	100·0	142	100·0

Evidently the hand brake continues in favour, but probably to no greater extent than in this country; and, roughly speaking, air brakes increase while electric brakes decrease, after the weight of cars passes 10 tons. The greatest number of cars weigh from 6 to 10 tons, and in that class the electric brake out-numbers the air brake in about the proportion of six to one:—

Hand brake	...	...	...	4,577
Electric brake	...	...	...	6,678
Air brake	...	...	...	949
				12,204

No other brake is so rapid in application as the electric brake, and the air brake suffers also in the comparison of first cost and maintenance ; but it is not uncommon to find electric brakes being used with motors which suffer because they were designed only for driving the car, and are not large enough to do the work of retardation also. M. Petit justly points out that the first cost of electric brakes, and the expense due to maintenance, cannot be stated accurately, because the duty of the motors is divided in this manner ; but there is not so much to be said for his argument that motors which are made large enough to perform both duties comfortably are less efficient than the smaller motors, therefore costing some undetermined amount which ought to be charged against the brake.

M. Petit, unfortunately, damages his case by the use of a palpable *impressio falsi*, for he says that the air brake has the advantage of being independent of the contact of the trolley wheel with the overhead wire.

The Paris Eastern Co. tops the record in rail length with 78 ft. 9 in., which no one will try to beat if he is wise.

Few have dared to go beyond 45 ft., and the English permanent way foremen who have had to lay rails in 60 ft. lengths are not enthusiastic about them.

The Falk cast-welded joint has been used widely in France, but the simpler Thermit joint is receiving more attention, and several mechanical sole-plate joints are being tried experimentally.

Most of the street tracks in France, Spain and Italy are laid on ballasted sleepers, which M. Dubs, who reports on this subject, favours because of their greater flexibility than the concrete foundation which is usual in England, Belgium and Germany.

The day of the long bond has passed, the flexible concealed bond having taken its place.

Manganese steel special work is in general use throughout France.

M. Dubs believes that corrugation is caused by the vibration of the rail, but, pretty as his theory is, he has to assume the whole foundation.

Hamburg, Barmen-Elberfeld, Bremen, Frankfurt, Mulhausen, Dusseldorf and Hagen, of the German tramways, have equipped every car with meters, and a great number of others have installed them on a few cars.

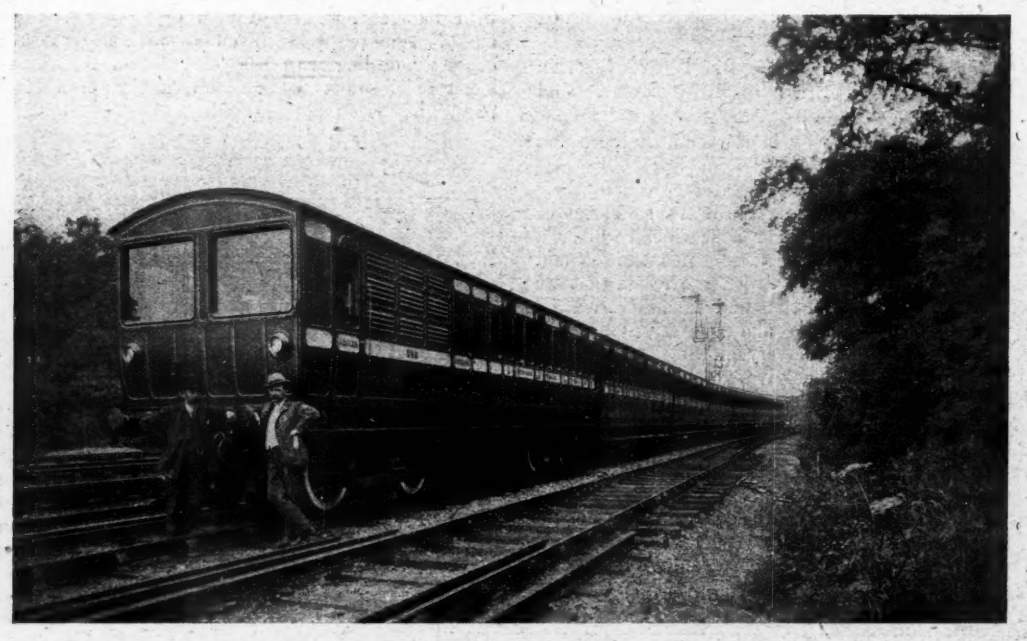
M. Wattmann reports that the wattmeter is being superseded by the time-meter, and it may be anticipated that the cheapness and simplicity of the latter instrument will lead to an extension of its use, particularly as the Germans have shown themselves for a long time anxious to have an automatic check on the drivers. The replies from Frankfort, Düsseldorf and Hagen, show that the time-meters have produced a notable decrease in energy consumption.

Prof. G. Rasch discusses the relative merits of the closed and open systems of feeding a large tramway network, and sees much advantage in the former, so long as the various feeders and sections are protected by suitably set circuit-breakers. We think that this subject has not been discussed at any length in England, so that it is difficult without individual inquiry to say which system is most favoured.

So long as careful arrangements are made to localise a fault in the shortest time, and with the least interruption to traffic on other sections, the closed network must present an economical advantage.

THE CONVERSION OF THE METROPOLITAN STEAM TRAINS FOR ELECTRICAL WORKING.

When electric traction was inaugurated on the Metropolitan Railway, the company found themselves possessed of nine trains, each consisting of seven coaches, built as recently as 1900, and which, having been designed for steam haulage, were now practically useless. It was recently determined to make the experiment of electrifying these trains, and thus again bringing into service rolling stock which would otherwise have to be written off as a loss. A contract was placed with the British Thomson-Houston Co., Ltd., of Rugby, and the experiment was made with two trains, which have now been operating satisfactorily for some time. The trains at present comprise seven coaches each, consisting of two motor coaches and five trailers. An extra trailer may be added later when the platforms at the stations have been lengthened sufficiently to accommodate the extra length of train. Each motor coach is equipped with four G.E. 69 motors, which are rated at 200 H.P. each, thus giving a total of 1,600 H.P. per train, a power which is capable of driving the train at a maximum speed of 45 miles per hour on the level and of making a schedule speed of 16 miles per hour. The method of control is by the Sprague Thomson-Houston



Metropolitan Train Converted to Electrical Working.

multiple-unit system, the master controllers being placed in each end of the train, so that the trains may be operated from either end. The contactors, switches, &c., are placed in what was formerly the guard's compartment, but which has been converted into a motorman's compartment, and are conveniently arranged for ease of examination and inspection. The weights of the train, unloaded, are as follows :—

	Tons.	Cwt.	Qrs.	Lb.
Complete seven-coach train ...	171	16	1	0
Single motor coach	38	2	2	0
Single trailer coach	19	2	1	0

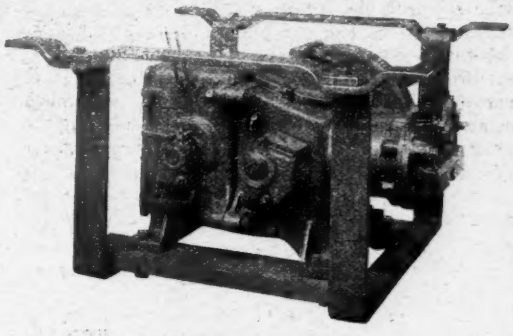
Each train has a seating capacity for 400 passengers, being 280 third-class and 120 first-class passengers.

The length over buffers of the complete seven-coach train coupled, is 289 ft.

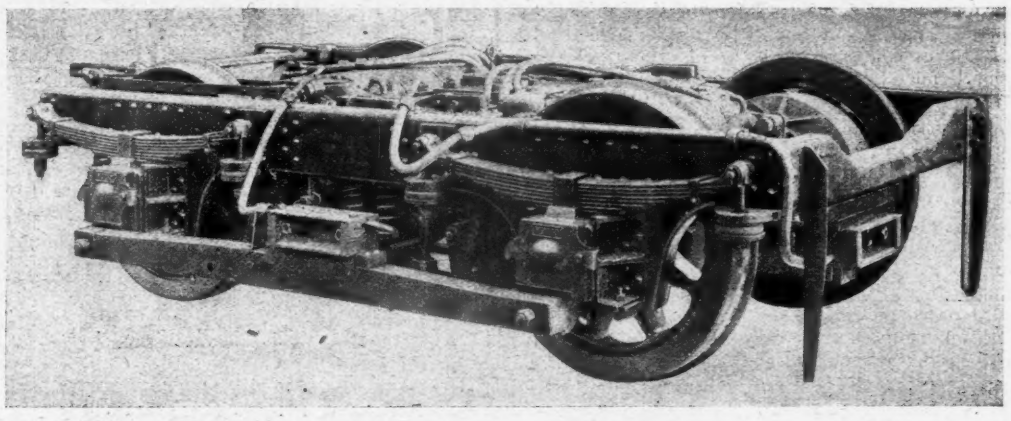
The original bogies, which are of the Fox pressed steel type with 7 ft. wheel base, 5 in. axles, and 40⅝ in. Mansel wheels, have been retained under the trailer coaches, but new bogie trucks, also of the Fox pressed steel type, with 7 ft. wheel base, 6½ in. axles, and 38 in. (wrought centre) steel tired wheels, have been provided for the motor coaches of these trains.

Automatic quick-acting air brakes have been substituted for the vacuum brakes formerly in use, and a hand brake is also provided in each driving compartment. The air compressors used are the well-known B.T.-H. type C.B. 22 compressors, of which the reliability is now well appreciated by railway managers.

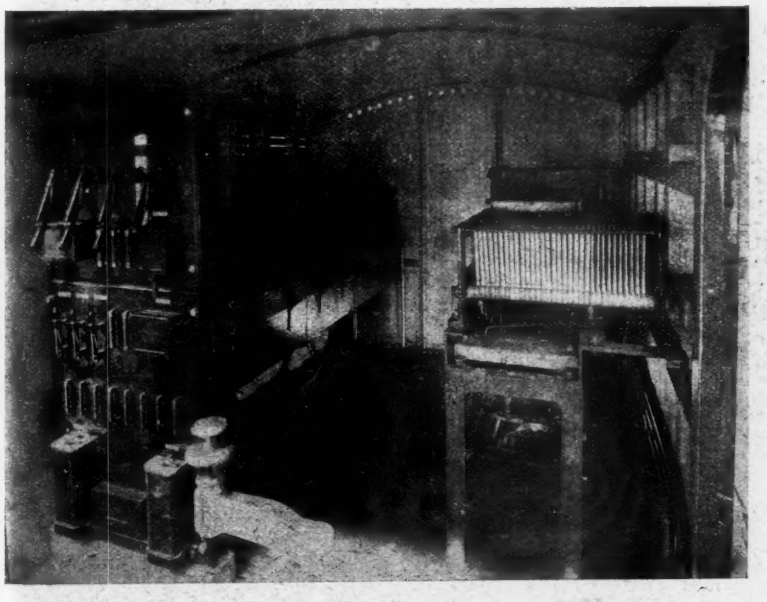
The under-frames of all the coaches are identical, being made up of 9 in. × 3 in. × ½ in. steel channels in the usual way. No change whatever has been made in the under-frames of the trailer coaches, and in those for the motor-coaches, 7 in. × 3 in. × ½ in. longitudinal channels have been substituted for the diagonals on either side of the bolsters over the centre of the bogies, in order to facilitate the inspection of the motors and to allow of a better arrangement of the wiring.



B.T.-H. Air Compressor.



Pressed Steel Motor Truck, with Electrical Equipment.



Driver's Compartment, showing Controller Handle in foreground.

All wires and cables are enclosed in cold-drawn solid steel tubing with standard thread and fittings, and all connections and joints in the wiring are made by means of special connection boxes containing connectors mounted on slate bases. The entire under-sides of the floors of the motor-coaches are sheeted over with ½-in. uralite, whilst the upper surface is provided with a ¾-in. layer of Paris cement, such as is used for flooring surface in steel car construction. The surfaces of the floors of the trailer coaches are similarly treated, and that portion of the under-side directly above the steel tubes containing the train line wires is also protected by uralite sheeting.

The train is lighted throughout by electricity.

In each motor-coach there are four third-class compartments, providing seating accommodation for 40 passengers, and there is also a luggage compartment. The two trailer coaches attached immediately to the motor-coaches each contain seven third-class compartments and seating capacity for 70 passengers. The middle trailer coach contains six first-class compartments with seating accommodation for 60 persons. The two trailer coaches on either side of the

middle coach, each contain three first-class and three third-class compartments with seats for 60 persons. The two trains have been repainted and newly upholstered, and are intended for use on the Baker Street, Harrow and Uxbridge line. It is expected that the other seven trains of this stock will be similarly equipped.

The first of these two trains went into service on July 11th, and has been making an average of about 200 miles daily.

The success attending this conversion of steam rolling stock to electrically-operated stock should afford much encouragement to other companies who are considering the advisability of electrifying portions of their routes, as it has clearly demonstrated the possibility of profitably employing present stock and so eliminating a by no means inconsiderable factor in the cost of converting a railway.

THE COMPULSORY WORKING OF PATENTS.

In a former article we dealt with certain aspects of the scheme for the compulsory working of patents which is being promoted by Sir Joseph Lawrence backed by the Associated Chambers of Commerce. Without committing ourselves at the time to any opinion on the expediency of the proposed reform of the Patents Law, we endeavoured to show the grave inaccuracy of some of the figures put forward by Sir Joseph Lawrence in support of his views.

We now propose to consider the general question of the compulsory working of patents from the point of view of "common honesty" and "expediency," the two determining factors in the granting of patent rights to inventors, as brought out so clearly by the writer in the *Quarterly Review* cited in our previous article.

A patent, we take it, is a temporary monopoly granted by the State to an inventor in order to enable him to develop an infant industry arising from the creation of the inventor's brain. It is the interest of the State to encourage such infant industries, as industrial progress depends on a sufficient number of them arriving at an efficient and productive manhood. Sufficient inducement is apparently given to the inventor to develop his invention, by granting him a monopoly for 14 years or some such period. This is the result of the experience of all countries with Patent Laws. If this period were greatly reduced or if Patent Laws were abolished, there would be no inducement to anyone to take the risk of expending large sums of money in developing these infant industries, on which industrial progress depends.

As a consideration for this monopoly, the State expects the inventor to publish a description of his invention, and, if it should be of any commercial value, to manufacture his invention and supply the reasonable demands of the public. If he supplies his labour-saving appliance to the public, the public benefit sufficiently by the saving of labour which his invention effects. They have no right to dictate to him where he shall manufacture his invention. He is the best judge of that; as a shrewd commercial man, he will no doubt manufacture in the country where he can manufacture cheapest, and it savours very much of the Protectionist idea to attempt to make him manufacture in the country where the patent has been granted, and where, presumably, he has decided that the cost of production would be greater.

It does not follow, however, as Sir Joseph Lawrence assumes, that the employment of capital and labour in the country where the patent is granted is not increased because the patented article is not manufactured in that country. The actual cost of manufacturing a patent article, as we pointed out in our previous article, may be a very small fraction of the cost of bringing it to the consumer for use. The cost of manufacturing a telephone, for example, is but a small fraction of the total cost of conductors, switchboards, buildings, &c., required to place the telephone at the disposal of the public. All, or nearly all, the capital and labour employed in distributing the patented article to the public must necessarily be that of the country where the patent is granted.

It is conceivable, of course, that a country might be deprived of any of the benefit which it has the right to expect for the grant of a patent, if the inventor refused to supply on any terms the patented article. But it is very doubtful whether there are any patentees in existence who do not desire to make as much as they can out of their patents. Can we imagine a foreigner obtaining a patent in this country and foregoing all the profit that he might obtain by its sale in this country purely for the purpose of retarding our industrial progress? Such eccentric patentees, we believe, have no existence except as bogies created by the turgid imagination of Sir Joseph Lawrence and his supporters.

But if there are any such insane or Anglophobe foreigners holding patents in this country, our present Patent Law confers sufficient powers on the authorities to deal with them. By applying first to the Board of Trade and then to the Judicial Committee of the Privy Council, any manufacturer may obtain a compulsory licence to manufacture the patented article, or, if the Judicial Committee are of opinion that the reasonable requirements of the public will not be satisfied by the grant of licences, the patent may be revoked by Order of Council. In order that the inventor shall not lose his property when his failure to supply the public is through no fault of his own, there is a proviso that no order for revocation shall be made before the expiration of three years from the date of the patent, or if the patentee gives satisfactory reasons for his default.

Our present Patent Law seems, therefore, to comply with the principle of "common honesty." We do not deprive an inventor of the property created by his brain, because he happens to be a foreigner, provided he supplies us with his labour-saving invention, and communicates to the public such a description of his invention, that it can be worked when his patent expires. Our law also has regard to the principle of "expediency" by compelling the recalcitrant inventor to grant a licence or to lose his patent, if he refuses to supply the reasonable demands of the public.

The procedure for obtaining the compulsory licence is somewhat expensive, and if any reform in our Patent Law is required, it is the simplification and cheapening of this procedure.

In the light of these theoretical views on Patent Law, let us examine the proposals of Sir Joseph Lawrence.

The resolution of the Associated Chambers of Commerce submitted by Sir Joseph Lawrence's deputation to the President of the Board of Trade was as follows:—

"That a deputation wait upon the President of the Board of Trade to show the necessity of further amending the Patent Law by legislation which would enforce in the United Kingdom the forfeiture of all British patents for invention which are worked without, but not within, the United Kingdom after the lapse of three years from the date of application in the country of origin, unless the patentee can justify his inaction to the satisfaction of the Board of Trade."

Sir Joseph Lawrence explained to Mr. Lloyd-George that this proposed amendment did not seek to discriminate against foreigners, and Mr. Lloyd-George apparently accepted this assurance. But, as a matter of fact, the vast majority of inventors holding British patents, and who work their patents without, and not within, the United Kingdom, must be foreigners. This being so, the amendment must necessarily discriminate against foreigners, and would in that case be an infringement of the International Patents Convention, to which we are a party.

The object of the proposed amendment is clearly to compel holders of British patents to establish manufactures in this country which can be more profitably carried out in another country. The result of this would be to raise the price of the article to the consumer, in order to benefit some of our manufacturers. The holder of a British patent manufacturing abroad, is threatened with the loss of his property if he does not manufacture in this country, though the cost of production here may be much higher. If this is not undiluted Protection, it is Protection only very slightly diluted by an offer of an appeal to the Board of Trade.

Mr. Lloyd-George, in replying to the deputation, said:—"I agree that this is not a matter which has anything to do with Free Trade or Protection. I repudiate that suggestion altogether." A little further consideration of this matter

will, we venture to think, compel Mr. Lloyd-George to alter his opinion.

A few extracts from Sir Joseph Lawrence's article in the *National Review* will reveal the cloven hoof of Protection which was so carefully concealed by the deputation as to deceive even a Free Trade Liberal Minister. One grievance of Sir Joseph Lawrence and his supporters against the British patent system is :—"That it gives to foreign inventors holding British patents advantages in Great Britain which are denied to British inventors holding foreign patents in countries outside Great Britain." If, in this sentence, we substitute "Free Trade" for "British patent system," "foreign manufacturers" for "foreign inventors, &c," and "British manufacturers" for "British inventors, &c.," we have a readily recognisable Tariff Reform maxim.

Here is another quotation from the article in the *National Review* :—"Englishmen in the past were able to manufacture and ship patented goods to European and other countries without fear of Patent Laws or hostile customs." Sir Joseph evidently has a grievance against any foreign country having a Patent Law. He wishes improved facilities for depriving foreign inventors of their property in this country, and would even go so far, if he could, as to deprive them of their property in their own country, so that British manufacturers might benefit by importing and selling at their own doors, the inventions taken from the foreigners. The application of the principle of "common honesty" is not much in evidence here.

Sir Joseph Lawrence does not consider that the compulsory licence obtainable under the present Patent Law is so effective as the compulsory working with the alternative of revocation which he advocates. He says : "The process of obtaining a compulsory licence in England is tedious, costly, and, worse still, uncertain in its results, because the licence when obtained may be useless. A person who obtains a licence does not always succeed to the complete mature knowledge of the patentee. A licence may simply mean a right to work under a patent without giving the licensee any assistance whatever ; while many a patent does not accurately describe the invention as carried out three years afterwards." But will the British manufacturer be any better off with compulsory working ? What will happen under the latter arrangement will be either (1) the patent will be revoked, in which case the manufacturer need expect to receive no assistance from the inventor ; or (2) a factory will be established in this country by the foreign patentee, on the minimum scale allowed. Does Sir Joseph Lawrence suppose that the British manufacturer will be invited into this factory to learn all the tricks of the trade that are not revealed in the patent specification ? He will be in no better position in this respect than if the patent were manufactured in Germany.

The above discussion appears to have made it clear that the proposal to enforce compulsory working of British patents (1) is a protectionist device to bolster up decadent and inefficient British manufacturers by legislative enactment ; (2) that there is at present no real grievance to remedy, and if such a grievance should arise, the present Patent Law is sufficient to cope with it ; (3) that the proposal discriminates against foreigners in spirit, if not in letter, and is, therefore, a contravention of Art. 2 of the International Patents Convention.

It is to be hoped that the President of the Board of Trade, who, from his reply to the deputation, seemed to be inclined to do something, will reconsider the matter, and refrain from the attempt to get the sanction of Parliament to an amendment of our Patent Law which would be contrary to the principles both of "common honesty" and of "expediency."

DIRECT-READING CONDUCTIVITY BRIDGE FOR SHORT RODS.

In a Paper published in the Minutes of *Proceedings* of the Institution of Civil Engineers, Vol. CLXIV, Part II, Mr. Rollo Appleyard describes a direct-reading instrument which he has devised for the measurement of the electrical conductivity of rods of such material as iron, steel and alloys. This instrument eliminates the end-contact resistance of the test-rods, it provides for the compensation of small differences of diameter or of mass between test-rods, it enables measurements to be made throughout a wide range of conductivity, and it is simple and rapid in operation. The arrangement of the electrical part of the bridge is that described by Mr. Appleyard in the *Philosophical Magazine*, June, 1896 ; it will be readily understood from fig. 1, which may be regarded as diagrammatic. The advantage of this arrangement is that in all positions of the slider the necessary condition for the Kelvin principle to hold good is maintained automatically. In the actual instrument, only the middle portions of the two parallel slide wires are exposed. In fig. 2, p. 692, which shows one form of it, these exposed portions of the wires are seen at the lower part of the bridge board, near the middle. The unexposed portions of the slide-wires are wound respectively upon four bobbins beneath the board, the ends being connected to R_1 and R_2, as shown in fig. 1. The resistance R_1 is a standard rod of known conductivity ; R_2 is a test rod of unknown conductivity, balanced against R_1. The length of the test-rod is known, and is constant, being the distance between the two fixed clamps shown in the upper part of fig. 2 ; the *nominal* diameter or mass of the test-wire is known, and its *actual* diameter or mass is measured as part of the test. The standard wire, R_2, is seen in fig. 2, extended the full length of the board, just beneath the long scale. Below it, in fig. 2, is a parallel stout copper bar carrying a single slider which makes contact with the

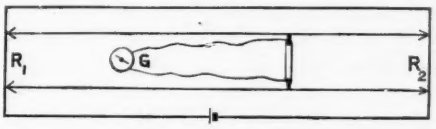


Fig. 1.

standard wire. To obtain balance, the length of R_1 is varied by moving this slider. The double slider, represented in fig. 1, is used, in this form of the instrument, only for compensating for small differences of diameter or of mass between any given test-wire and the nominal diameter or mass. This double slider appears at the bottom of fig. 2, near the middle. A battery key and a galvanometer key complete the apparatus, so that it is only necessary to attach a low-resistance galvanometer and a battery to the terminals marked for the purpose in fig. 2.

In the Paper (l.c.) Mr. Appleyard first gives the proof that a bridge of this kind has the same equations of equilibrium as the conductometer,* so that the compensating scale is graduated in a manner identical with the scale of that instrument, and is used in exactly the same way. The theory of the graduation, in direct percentages, of the scale of the standard wire, extending along the whole board in fig. 2, is then given ; and further, it is explained how, as an alternative, this scale can be calibrated from two or more readings taken with test wires of known conductivities. An instrument of this kind was tested by the National Physical Laboratory against six rods, the conductivities of which had been previously determined by an accurate method ; these were balanced successively upon the Appleyard conductivity bridge, with the following results :—

National Physical Laboratory measurement. Conductivity %.	Appleyard conductivity bridge reading. Conductivity %.
2·0	2·01
2·5	2·52
5·0	4·99
7·5	7·48
10·0	10·0
20·0	20·0

It is pointed out by Mr. Appleyard in the Paper that five of these values correspond to the same standards as were used in the calibration ; for a strict comparison he therefore rejects these five from the figures representing the probable precision of the instrument. The conductivities 7·5 and 7·48 are, however, entirely free from this objection, and may

* "The Conductometer and Electrical Conductivity." (H. Alabaster, Gatehouse & Co., London, 1904.)

be accepted as completely representative. To indicate the degree of accuracy with which differences of diameter can be compensated, the National Physical Laboratory varied the diameter-equivalent of four standard rods, so as to represent "light" and "heavy" test-rods, respectively—all of the *nominal* diameter 220 mils. The results obtained were :—

Rod diameter.	Mils difference from nominal 220.	Appleyard conductivity bridge reading.	National Physical Laboratory value by accurate method.
"Light"	− 1·0	10·15	10·08
"Light"	− 10·0	11·05	10·95
"Heavy"	+ 1·0	9·92	9·93
"Heavy	+ 10·0	9·15	9·13

This instrument is made by the India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd., Silvertown.

The Paper includes an account of an alternative construction, whereby the single slider is dispensed with, and the compensation for diameter or mass differences is obtained by means of an auxiliary scale to which the double slider is set. A general expression is given for the graduation of such a scale so that it shall compensate for small differences of diameter or mass of wires of any required conductivity. As the instrument is direct reading, the time occupied by a measurement when the diameter has been determined is only the few seconds necessary to obtain balance ; and as the compensation scale setting for any given diameter difference is read off a table, the use of the instrument involves no calculations.

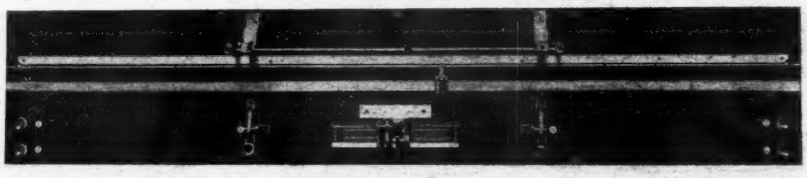


FIG. 2.—DIRECT-READING CONDUCTIVITY BRIDGE.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

22,208. "Improvements in the manufacture of electric lamps." W. E. BARRAS. October 8th.

22,217. "Improvements in or relating to electric motor controlling apparatus." F. KRIZIK. October 8th.

22,218. "Improvements in controllers for electric current of high tension." F. KRIZIK. October 8th.

22,221. "Improvements in and relating to dynamo-electric machines." BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., U.S.) October 8th.

22,224. "Lighting railway stations and platforms from the train by electricity." H. DITCHFIELD. October 8th.

22,253. Electrically operated timepieces. A. L. RAWLINGS. October 9th

22,312. Improvements in electric furnaces." F. A. KJELLIN. October 9th. (Complete.)

22,314. "Improvements in moulds for casting anode plates." R. TRUSTWELL. (Date applied for under Patent Acts, 1.01, October 9th, 1905, being date of application in United States.) (Complete.)

22,319. "Process for increasing the electrical capacity of spongy lead plates for storage batteries." J. DAIMANT. October 9th. (Complete.)

22,325. "Improvements in and relating to electro-magnetic separators." W. BLACKMORE. October 9th.

22,342. "Improved insulated covering for the couplings or terminals of electrical cables." W. MIDDLETON and J. Y. MIDDLETON. October 9th. (Complete.)

22,345. "Improvements in and relating to signalling systems and apparatus therefor especially applicable to railway and like signalling." J. GRAY. (Allgemeine Elektricitäts Gesellschaft, Germany.) October 9th.

22,347. "Improvements in and relating to the control of electric motors." THE BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) October 9th.

22,406. "Magnetic tack hammer." A. DOCKER. October 10th.

22,492. "Improvements in and relating to dynamo-electric machines." THE BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) October 10th.

22,465. "Improvements in controlling mechanism for electric lifts and other purposes." J. C. ETCHELLS. October 11th. (Complete.)

22,489. "Improvements in electric arc lamps." JOHNSON & PHILLIPS, LTD., and C. FRANKLIN. October 11th.

22,497. "Improvements relating to the ventilation of electrical machines." P. A. LANGE. October 11th.

22,498. "Improvements in electrical measuring or indicating instruments." H. P. DAVIS and P. MACGAHAN. (Date applied for under Patents Act, 1901, October 21st, 1905, being date of application in the United States.) October 11th. (Complete.)

22,500. "Improvements relating to electric conductors." P. G. B. COLLYER. October 11th.

22,519. "Improvements in electric transformer furnaces." O. FRICK. (Date applied for under Patents Act, 1901, December 18th, 1905, being date of application in Sweden.) October 11th. (Complete.)

22,537. "Improvements in methods of and devices for neutralising inductive disturbances in electric conductors." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) October 11th.

22,547. "Improvements in secondary batteries." H. F. JOEL. October 12th.

22,549. "Improvements in electric switches." A. ECKSTEIN and A. C. HEAP. October 12th.

22,576. "Improvements in connections for electric tramways and other overhead electrical conductors." J. H. KING and E. PARISH. October 12th.

22,605. "Improvements in alternating-current commutator machines having compensation windings" SIEMENS-SCHUCKERTWERKE G.m.b.H. (Date applied for under Patents Act, 1901, June 13th, 1906, being date of application in Germany.) October 12th. (Complete.)

22,606. "Improvements in tremblers for induction coils." H. G. PRESTED. October 12th. (Complete)

22,617. "Improvements in brush-holders for dynamo-electric and similar machines." THE JOHNSON-LUNDELL ELECTRIC TRACTION CO., LTD., and H. LUBECK. October 12th. (Complete.)

22,625. "Improvements in and relating to dynamo-electric machines." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) October 12th.

22,631. "Improvements in multiple carbon arc lamps." W. MATHIESEN. October 12th. (Complete.)

22,641. "Improvements in electric arc lamps." E. R. GROTE and M. V. ELY. October 12th.

22,647. "New safety portable manual electric generator for lighting miners' safety lamps." J. C. BOWIE and J. H. PHELPS. October 13th.

22,658. "Apparatus for the electrolysis of fluids." E. WEICHERT. October 13th. (Complete.)

22,691. "Improvements in electric cables." S. PATTERSON and J. W. BASS. October 13th.

22,692. "Improved electrode for secondary batteries." E. HEYMANN. October 13th.

22,700. "Improvements in interlocking mechanism for enclosed electrical switches with removable contact plugs." H. W. COX. October 13th.

22,715. "Improvements in or relating to electric condensers or the like." J. A. L. DEARLOVE and S. G. BROWN. October 13th. (Complete.)

22,716. Improvements relating to electric warming devices." R. F. LAFFOON. October 13th. (Complete.)

22,717. "Improvements in electrical connectors more especially of the type used for bonding rails." THE BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) October 13th.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1905.

ELECTRICAL ALARM FOR INDICATING A STOPPAGE OR SHORTAGE IN THE COOLING WATER SUPPLY OF GAS ENGINES. H. Paetow. 18,685. September 14th.

METHOD OF ELECTRIC WELDING SHEET METAL. E. F. Rietzel. 18,909. September 19th. (Date applied for under Internaticnal Convention, February 24th, 1905.)

PRIMARY BATTERIES. C. Ruzicka. 8,781. September 19th.

ELECTRICAL RESISTANCES. A. H. Attridge and British Submarine Boat Co. 19,007. September 20th.

PROTECTIVE DEVICES FOR ELECTRIC DISTRIBUTION SYSTEMS. British Thomson-Houston Co. and E. B. Wedmore. 19,210. September 22nd.

HYDRAULIC LIFTS ELECTRICALLY OPERATED. E. M. T. Boddam. 19,483. September 26th.

ELECTRICAL TIME SWITCHES. E. Du Bois. 19,551. September 27th.

AUTOMATIC ELECTRICAL CIRCUIT BREAKERS. Crompton & Co. and R. C. Harris. 19,663. September 28th.

TROLLEY HEADS FOR ELECTRIC TRAMCARS OR THE LIKE. F. Hewer. 19,746. September 29th.

TREATMENT OF WOOD TO BE USED IN ELECTRO-CHEMICAL APPARATUS. D. H. Whitehead and Q. Marino. 20,143. October 5th.

CONDUITS OR CASINGS FOR ELECTRIC CONDUCTORS. R. H. W. Knight and L. Nagel. 21,071. October 17th.

ELECTRIC TRANSFORMERS, REACTANCES AND THE LIKE. British Thomson-Houston Co. (General Electric Co., United States.) 22,343. November 1st.

1906.

REPULSION ELECTRIC MOTORS. Akt.-Ges. Brown, Boveri & Co. 8,044. April 3rd. (Date applied for under International Convention, April 7th, 1905.)

TELEPHONE APPARATUS. R. Bines. 8,174.

ELECTRIC FURNACES FOR TREATING GASES. H. Pauling. 8,452. April 9th.

TREMBLERS FOR INDUCTION COILS. C. H. Bryant. 8,915. April 12th.

MAGNETO-ELECTRIC IGNITION APPARATUS FOR USE IN CONNECTION WITH INTERNAL COMBUSTION MOTORS, GUNS AND THE LIKE. T. Bergmann. 9,234. April 19th.

ELECTRIC HAMMERS. W. P. Wegner and A. Wendelburg. 9,612. April 24th.

ELECTRIC GLOW LAMPS. Siemens & Halske Akt.-Ges. 9,772. April 26th. (Date applied for under International Convention, May 31st, 1905.)

PRODUCTION OF HIGH-TENSION ELECTRIC CURRENTS. C. R. Bronk and A. F. A. Pieper. 10,054. April 30th.